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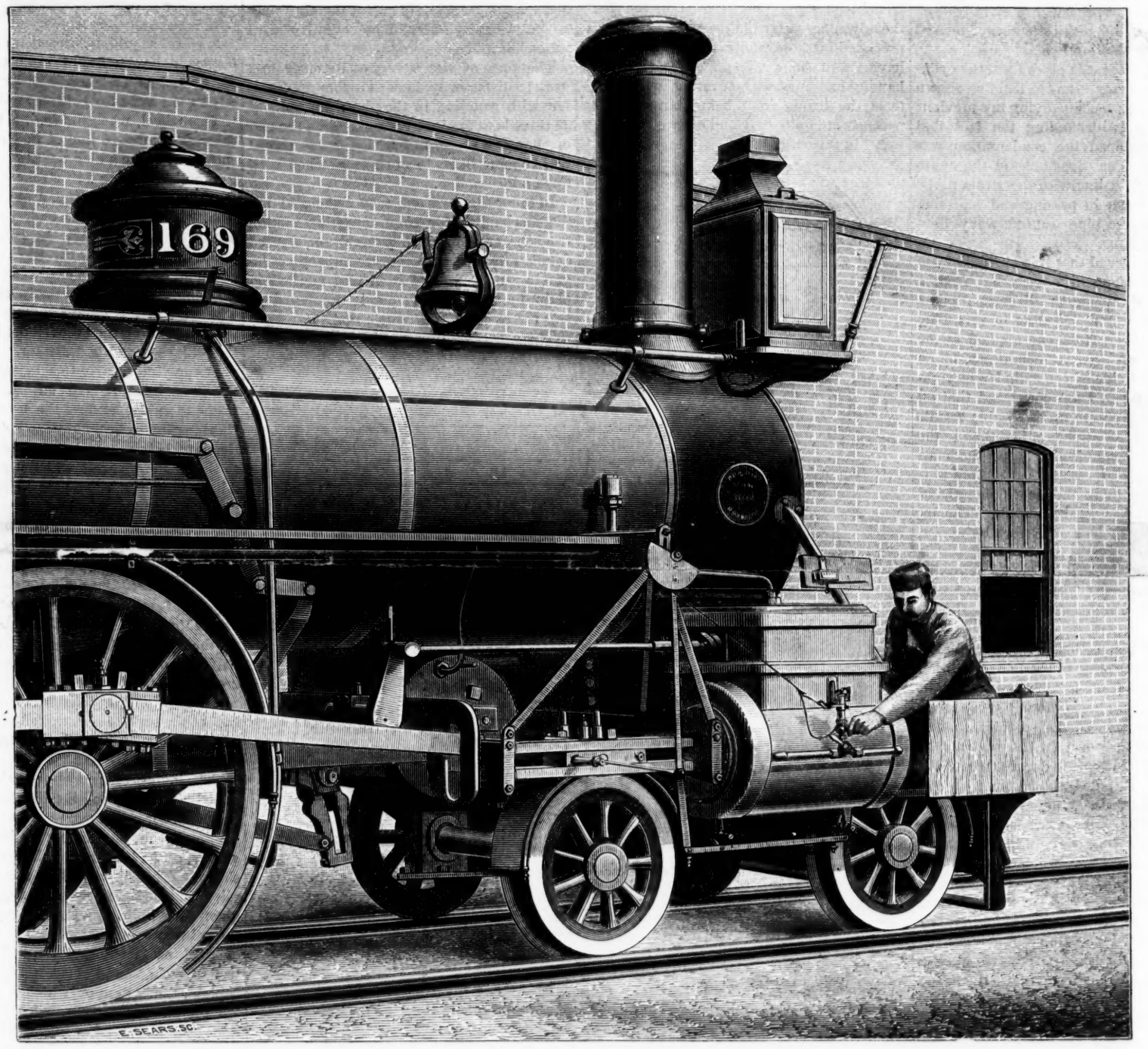


NEW INDICATOR RIG FOR LOCOMOTIVES.

New Indicator Rig for Locomotives.

BY LEWIS F. LYNE.

Since the publication of my former article on indicating a locomotive at high speeds, in the AMERICAN MACHINIST of August 28, 1880, I have made a still more careful study of the subject. This has been done at intervals during the limited time that could be taken from my regular duties. I have endeavored, through various conversations held with different master mechanics, to arrive at some conclusion as to the reason why the indicator is not more generally used in determining the true economical working of locomotives.

I find that the usual methods of applying the indicator to locomotives require the cylinder covers and casings to be cut in a barbarous manner which is very objectionable. The application of an indicator to one locomotive does not give any definite information in regard to the condition of others upon the road. To apply the indicator to each locomotive in the usual way would be entirely out of the question, because of the necessity of devising a different rig for each class of locomotives. It is often argued among railroad men and builders of locomotives that two engines, built precisely alike from the same patterns by the same firm, will work entirely different from each other, and with varying degrees of economy. If the indicator had been applied to these locomotives by a competent person, I am convinced that the truth would have been developed and a reason established for the discrepancy. It should always be remembered that *without cause there can be no effect*, so it is our business to find the cause.

I will here give only one instance of the truth of my assertion, as I fully believe in a practical demonstration of all theories. A certain master mechanic had two locomotives built of equal sizes, and as far as possible precisely alike. When they were put upon the road it was found that they worked entirely dissimilar; one would pull a train easily while the other would labor very heavily in doing the same work. These facts which are common upon nearly every rail road, in this instance were freely discussed. It was suggested that an indicator be applied to ascertain the cause of the trouble. Accordingly some diagrams were taken which showed a wire drawing of the steam at one end of the cylinder.

The steam chest covers were removed, the pistons placed upon the centers, and the clearances filled with water from a bucket that had been accurately weighed. It was found that the steam port at the end, in which the wire drawing appeared upon the diagram, had several cubic inches less capacity than the others, which were very nearly alike. The piston was removed, and with a light the port was carefully examined. It was found that in moulding a portion of the core had broken, so that when the cylinder was cast about two inches was taken off the length of the port. Here was an instance where the indicator pointed out an effect so clearly that the cause was easily discovered and remedied. It should be remarked that after the lumps were removed from the port no one could detect any difference in the working of the two locomotives. Several instances of this kind have come within my notice.

The objections to the application of the indicator to locomotives seem to be wholly

of a mechanical nature, which can be quite easily overcome; for nearly every one now recognizes the fact that the indicator is the proper instrument to point out the defects in the working of steam engines.

I have endeavored to overcome mechanical difficulties by designing a universal indicator rig which may be applied to all styles of locomotives, and which will obviate the necessity for all cutting and injuring of the cylinders and casings.

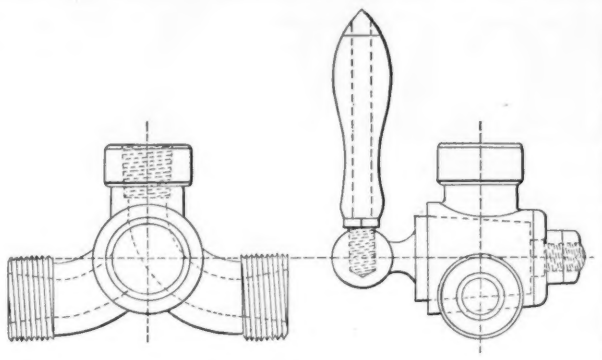
How this result is accomplished will be readily understood by an inspection of the engraving upon page 1. It represents an indicator rig that I designed and applied to locomotive No. 169, Central Railroad of New Jersey, through the kindness and co-operation of Mr. Wm. Woodcock, the master mechanic. Before describing this apparatus I must observe that during my former experiments, to which reference has already been made, certain difficulties were encountered which deserve mention here.

In the first place, the pipes from the cylinder to the indicator were too long, as shown in the engraving accompanying my previous article, and notwithstanding the fact that they were wrapped the condensation was considerable. The pipes entered the cylinder at a point in line with the steam ports, so that the steam in passing and repassing the mouth of the pipes caused wavy lines upon the diagrams.

It has been argued that this method of application makes no difference, but from a comparison of numerous diagrams, taken from an indicator attached as in this case, with others taken from one applied to the same engine under like conditions, to an opening in the side of the cylinder at right angles to the ports, I am convinced that an indicator will give far more reliable results when placed in the latter position, than in the former. Another objection was, the cord being too long and elastic, the stretch of it was plainly shown in the varying lengths of the diagrams taken at high speeds. The indicator rig shown in the accompanying engraving is very simple, inexpensive, and is capable of being applied to all kinds of modern outside connected locomotives, and may be used upon several styles, having inside connections.

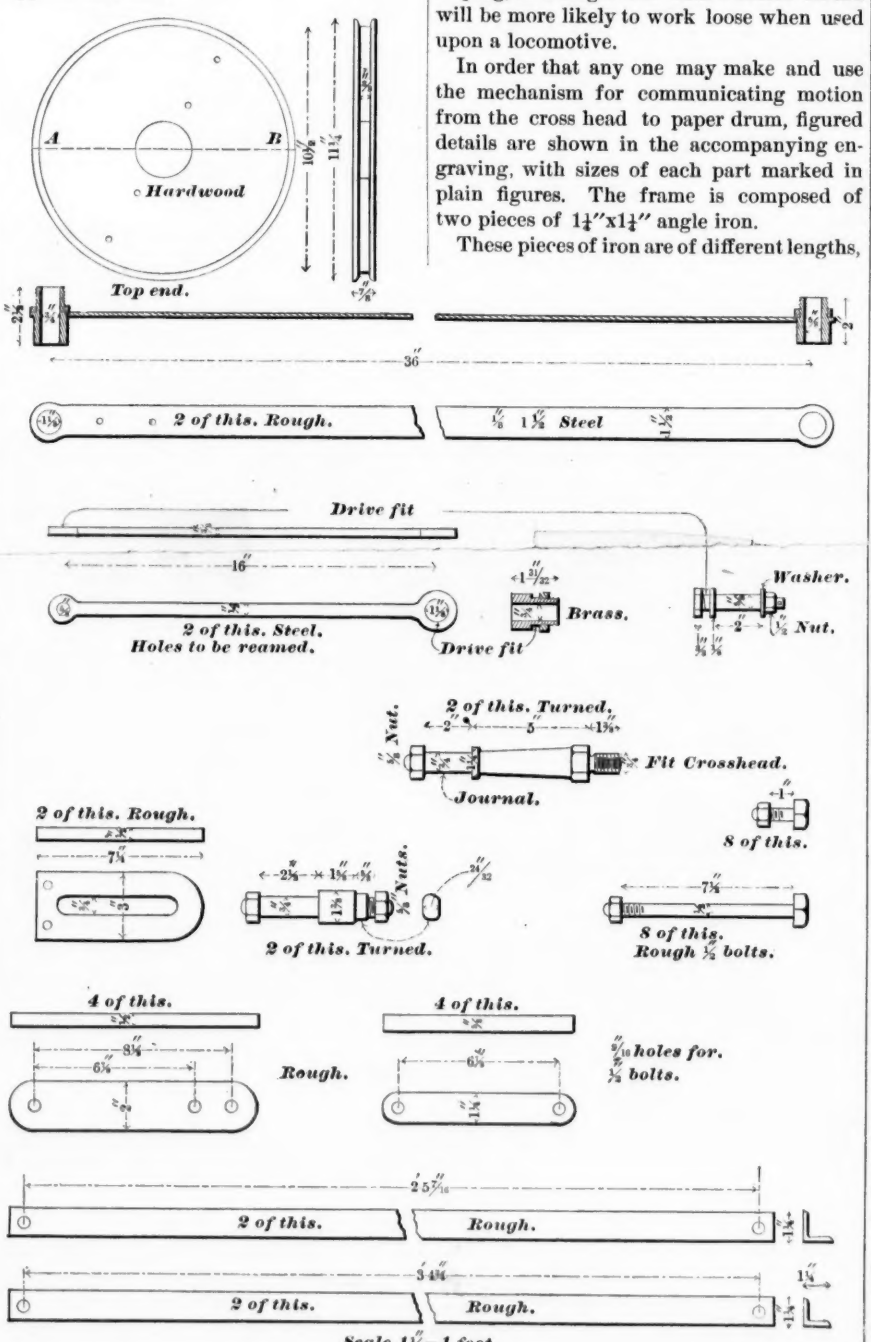
For making connections with the cylinder, a hole is drilled close to the flange at each end and tapped to fit a ¾″ nipple (wrought iron pipe). These holes should be so drilled as to clear the bore of the cylinder, so that the piston may not cover the holes at the ends of the stroke. In some instances, where the counter bore is but little larger than the diameter of the cylinder, a passage should be gouged from the clearance at the end to the hole communicating with the instrument. This is a necessary precaution, so that there may be no obstruction of the free passage of the steam from the cylinder to the indicator. After the holes have been drilled and tapped (which may be done without removing the cylinder casing or back cover), two nipples having ¾″ malleable iron elbows upon the ends, are screwed in place. These should be tightly screwed up, and set looking towards each other.

Upon No. 169 one edge of the holes just touched the offsets formed by the ends of the bore of the cylinder, while upon the opposite sides the nipples just cleared the cylinder flanges. Two long nipples, having brass collars brazed upon one end, are then cut of a proper length to fill the space between the elbows and cock. Brass should always be used for the collars as spelter solder will not run through the threads if the collars are of wrought iron. The end of one of these nipples is to be cut in the usual way and tightly screwed in place while upon the other nipple the die is run up 1½″ for the application of a lock nut. It is then screwed into the elbow, the three way cock is put in place, the joints being made with washers of annealed sheet copper. Rubber and all other fibrous material causes trouble when used for making these joints. The nipple having the lock nut is screwed out from the elbow until the joints are firmly made upon the cock, then the lock nut is to be set up against the face of the elbow, a few strands of lamp wick having previously been wound between the two surfaces to avoid any possibility of leaks. The ends of all the pipes should be carefully rounded inside with a file, and nothing but clean oil should be used in making the joints. If red lead is used, the operator, in taking the diagrams, will have the dissatisfaction of seeing his instrument stick, and will be obliged to remove the piston frequently and pick the lead and dirt out of the instrument.



Three Way Cock.

The three-way cock, shown on this page, is of a pattern I had made to suit my taste. There is plenty of metal used in the shell, the advantages of which will be readily appreciated by those who have used plug cocks having thin shells. The brass center of the handle has a wooden covering, which protects the hands from being burned. The passages are quite easy and of large diameter —$\frac{9}{16}$″ in this case.



Scale 1¼″=1 foot.

Details of Indicator Rig.

The top of the cock is tapped for half-inch pipe, which fits the stop cock for the indicator. I use collars in making pipe joints against each end of the cock, preferring that way to the one in which a stuffing box is made in one end of the cock.

If the pipes are put up properly, there will be no trouble caused by the difference in expansion between the pipes and the cylinder of the engine. The washer upon the plug has a square hole through it, in which a square groove is turned opposite the edge of the shell.

A brass ring is turned to fit the groove, a steel pin is placed in the end of the shell, and a section of the brass ring is cut out sufficiently to allow the plug to be turned, so as to open the cock for both ends of the cylinder. After marking in place, the ring may be permanently fastened by sweating with soft solder.

This form of stop is very easily made and works satisfactorily, besides it does not interfere with grinding in the plug; jam nuts of 22 threads to the inch are used upon the end of plug, as a single nut with a coarse thread will be more likely to work loose when used upon a locomotive.

In order that any one may make and use the mechanism for communicating motion from the cross head to paper drum, figured details are shown in the accompanying engraving, with sizes of each part marked in plain figures. The frame is composed of two pieces of 1¼″x1¼″ angle iron.

These pieces of iron are of different lengths, and have their lower ends bolted to clamps made of ⅛″x2″ bar iron held to the guides as shown in the engraving on first page. The clamps upon the inside of the guides are of ⅝″x1½″ iron, or whatever size will clear the piston gland and cross-head to answer for all the locomotives intended to be indicated.

The blocks placed between the outside of guides and clamps are of hard wood, of a proper length to bring the lever in line with the pitman. The top ends of the frame are bolted to a slotted plate of ⅛″x3″ iron. This plate is placed outside the frames, same as the clamps. The plate here shown is for locomotives having from 22″ to 24″ stroke. If a greater range is desired this plate must be longer and the frames shorter. The reason is that the upper end of the lever is suspended from a ¾″ pin fitting the slotted plate, and as the length of the stroke is shorter or longer this pin must be lowered or raised, to equalize the vibration of front end of the pitman above and below the center line of its motion. The lever is made of ⅛″x1¼″ steel, having ends swollen out like eye bars to 1¾.″ The bushings are all of composition, made to drive fits in their places, and are held by nuts as shown. The pitman is of steel, and is 16″ long between centers of bearings. Connection is made with the cross head by means of the stud shown for that purpose. An angle piece of light iron should always be bolted to the cross head to prevent lateral vibration of the lower end of lever. The grooved arcs for the chord are made from cherry or other well-seasoned hard wood with a flat groove as shown.

A wheel should be turned up in a lathe of the shape shown; the hole in the center should fit the end of bushing in order to facilitate setting the same for bolting to the lever.

This wheel, when finished, is to be sawed through the dotted line *A B*. The size here shown will take a diagram 3½″ long upon a locomotive having 24″ stroke. To prevent the frame from vibrating, a rod of half-inch iron, with an eye at one end, is attached to one of the bolts through the running board, while the other end is threaded 4″ from the end, and has a nut placed each side of the slotted plate at the top of the frame, as shown. The stud in the cross head should be long enough to bring the grooved arc in line with the pulleys upon the indicator.

In applying this rig to a locomotive, place the cross head at half stroke, attach the frame to guides, and set the lever exactly at right angles to the guides and screw up all the nuts, being careful to spread the blocks so that the cross head will not strike them. All we now have to do is to adjust the lever vertically, which may be done in the following manner: With a pair of trammels set to the length of the lever, which in this case is 36″, describe an arc, and draw a straight line 24″ long, with the ends touching the arc. Measure from the center of the line to the arc, which in this case will be about 2″, and set the center of the lower pin in the lever half this distance below the center of the cross head, then tighten the nut on the upper pin. This will equalize the vibration, so that at the ends of the stroke the bottom end of the lever will be one inch above the center of cross head.

This laying out may, and should all be done beforehand, and the distances put down in a book for reference, so as to avoid delay. To prevent the chord from getting out of the groove, a wire loop should always be used, as shown. This rig, as will be seen, can be applied and adjusted without moving the engine. The indicator chord is very short, and the pitman connection quite long. The chord I use is the best-braided linen line, well stretched and lightly waxed. The box is plain, the bottom of which is held 9″ below the bumper beam by a ¾″ bolt through it and the flag stand, while the back end is supported by an iron bracket attached to the stud in the center of the cylinder head.

The counter is the same as used on former occasions, and is attached to a board bolted to the front brace, as shown.

In applying an indicator to the steam chest, I drill a hole in the center of the steam chest horizontally and vertically, then screw in a half-inch nipple and elbow, and set up my indicator in line with the grooved arc. The chord connection to this instrument will be very short.

Holes should be drilled in every cylinder while the engine is in the shop, and brass plugs, with hexagon heads, screwed into them. The cross heads, if not already drilled and tapped, as many of them are, should be, so that upon an hour's notice the indicator rig may be attached without the necessity of cutting the engine, or doing any carpenter work. In cold weather it is a very easy matter to erect a screen to protect the operator from the wind.

All are welcome to the ideas herein advanced, and it is hoped that, by removing existing objections, the advantages to be derived from indicating locomotives will be practically realized and appreciated by master machinists generally.

Comparison Between High and Low Speed Engines.

By Chas. A. Hague.

III.

In continuing our comparisons, the question of counterbalancing demands a passing notice. In small, fast-running engines it has been found that comparatively heavy reciprocating parts conduce to smoothness of action, and this without any particular efforts at counterbalancing. It being desirable in such cases to carry pretty high pressures, to enable a small engine to do heavy work, the shock of admission is met by the momentum of the moving mass, thereby preserving the connections from jar, but not preventing the reaction of the inertiæ from being transmitted to the framing to a certain extent; and when the steam lead is correctly adjusted the effect is satisfactory. But if, from wear of the valve gear, or from any other cause, the necessary conditions are not maintained, the engine after being in service awhile is very likely to pound at the centers. This, in a motor of from 20 to 50 horse power would probably not be of very great importance, but in an engine developing from 200 to 400 horse power any such irregularity is always expensive, and very liable to eventually prove fatal to the machine.

In some forms of small, high-speed engines, from 20 to 50 horse power, the feature is introduced of completely counterbalancing the reciprocating parts; that is, of placing a counterpoise in the revolving parts, whose momentum at the two extreme positions in the orbit of revolution, situated in the engine center line, just compensates for the inertia of the piston and connections in the opposite direction. In other words, the centrifugal force of this counter-weight in one direction is just equaled by the centrifugal force of the reciprocating parts, at the instant they are passing the center, in the opposite direction, and at this instant these parts present the same effect as though they were a mass simply secured to the crank pin. If this machine should be *driven* by a belt upon the balance wheel, it is reasonable to suppose that these two momentums or forces would counteract each other, and that at the point where these moving masses were held to the framing of the machine—that is, at the journal of the main shaft nearest the crank—equilibrium would be secured in the direction of the engine center line; and thus no tendency of the machine to vibrate endwise would manifest itself, other than the slight effects due to the different velocities of the reciprocating parts resulting from the angularity of the connecting rod. Although equilibrium is established at the main shaft journal, it is at the expense of the crank pin. For the opposing efforts of these opposite forces would be expended upon the point of connection between the two masses producing the forces; and although the framing—which should be heavy enough, by the way, to sustain any amount of shock and strain that it would pay to have the engine undergo—is saved from worrying its fastenings, although the largest and best-supported journal in the engine is relieved from the strain and friction that it is better calculated than any other to bear, the crank pin, one of the most vital and tender parts of the entire machine, is moving with extraordinary velocity under great pressure, and this pressure, at the instant of passing the center, is exactly at right angles to the movement of the pin.

Again, when the counterpoising weight passes the point in its orbit situated in a line at right angles to the engine center line, there is nothing to prevent the loss from frictional power due to the angular velocity of the main journal surface, multiplied by the friction resulting from the centrifugal force in pounds, of the counterpoise *less* the dead weight resting in the bearings, in one direction, and the product of the friction of the centrifugal force *plus* that of the dead weight in the opposite direction. In other words, when we make a small engine, and run it fast to produce power equal to a large one running slow, what is saved in friction, by reason of light weights, is most probably lost again through the effects of increased inertia, as forces pertaining to momentum and velocity increase as the square of the speed, while those pertaining to weight mainly, directly as the weight. In one form of horizontal high speed engine, the peculiar construction is such that the upward inertia of the counterpoise is entirely overcome by the amount and available distribution of the weight resting upon the main journal bearings, but this only results in so much additional pressure when the forces tend downward.

In the construction of this particular form of high speed motor just referred to, the arrangements are peculiar, and of a character that awaken our conservative faculties when the idea is suggested of embodying its principles in engines of considerable power. Setting aside other considerations, among them the employment and risk of four pressed fits instead of two, this complete counterbalancing feature in large engines would be likely to give trouble. We have already remarked upon the probable balance of centrifugal forces if the machine should be *driven* instead of being itself the driver, but when steam is introduced into the cylinder, and especially when excessive compression is employed, there seems to be a chance of interfering with the balancing effect by resisting the inertia of the reciprocating parts near the ends of the stroke, leaving the centrifugal force of the counterpoise without a direct balance; this effect, however, in small engines is not particularly noticeable. Through the medium of the suddenly compressed steam, the moment of inertia is transferred from the reciprocating parts to the cylinder head and thence to the frame, but the force of the counterpoise in the crank is in the opposite direction, and of just equal intensity if the entire force of the reciprocating members has been transmitted, thus throwing the reversing strain into the framing and against the main journal at the side nearest the counterpoise, but it saves the anchor bolts and foundations, and somewhat relieves the pressure upon the crank pin.

Now, with small engines, wherein the total effect of these forces is comparatively insignificant, any disturbance in the equilibrium by means of the elastic cushion interposed by the compression, is of little account; but when it is realized that very heavy masses, moving with great velocity in large engines, must be *very* nearly coincident in their effects to prevent shocks and jars, likely to prove sufficiently damaging to overbalance all our apparent gains, we are admonished to look very carefully before leaping to a conclusion.

Extracts from Chordal's Letters.

DIFFERENT KINDS OF FOREMEN.

Mr. Editor:

* * * * I actually believe that all the immense amount of rushing work now being done is done by fifty per cent. of the men employed on the work. Certain elastic workmen feel every change in times. When things are dull and but few hands working, the special ones of the few will do less in a given time than the balance. When things boom and the shop fills up, these chaps get enthusiastic and pitch in and do the work, and they keep doing it. Their rise in spirits is the only thing tending to keep up the average performance.

* * * * Priceless is the enthusiastic boss who can keep his hands off things. The temptation to take a dull-headed man's work out of his blundering hands is a strong one, but it must be resisted, or the boss sinks into a mere improver of a single blunderer's work, and as such is worth per day just the increase effected in one man's work, and no more.

* * * * John Paul was a foreman in a machine shop, and had charge of about a dozen men. Wherever you would find this foreman, John Paul, you would find a machinist standing close by watching John Paul do the work.

John Paul was a splendid workman and a good worker, but he did not know how to pick out good men, or how to make good men out of indifferent ones.

An extra heavy job had to go into a lathe. John sends Jim, a laborer, after a sixteen-foot ladder. In comes the end of the ladder, ubiquitously hitting everything in the shop, followed at half stroke by Jim, the clumsy, who carries it. Why should not Jim be as able as any one to engineer a ladder into and through a machine ship? He has been superintendent of that ladder for months, but has never been able to improve its running time. John Paul, with an impatient mutter, with eye and mind on the spot where he wants the top of the ladder to go, takes two quick strides, snatches the ladder from Jim, and, with one free, perfect, thoughtless movement, plants it in exactly the right place. I question if he thought of the process or of the ladder. He saw only the place up there. There is an eyebolt, close up to the flooring, between two joists. He tells Sam, the big lathesman, to go up the ladder with the chain block. Sam fusses with the hook and strains himself, works clumsily at arm's length, and runs his tongue out of the corner of his mouth, blows the dust out of his eyes, and wears himself out and gets shaky. John Paul twitches impatiently, for the thing is tiring him as much as Sam. He calls Sam down, takes the block up the ladder, hooks it in place and comes down again. Why could not Sam do a little thing like that as well as John Paul? Then there's a sling to rig up, and a chuck to take off at the eleventh hour, and a dog to get, and a tail stock to set, and a carriage to be run out of the way, and a tug on the chain, and a steering of things, and an oil can to get, and a center to oil, and a final and finishing screwing up of the center when the job is in place. Who does most of all this? The six men standing around? John Paul does it.

* * * * Do the men shirk? Not a bit of it. They pester John Paul by their abortive willingness. Then why does John Paul do this work? Another question too hard for me.

* * * * John Paul's brother-in-law, Paul Johnson, is a boss, too, and works fifty men. No ladders, or blocks, or chucks, or oil cans in his labor. He gives his orders and behold, the work is done as though he had an army composed of John Pauls working for him.

John Paul can only push one thing at a time. Paul Johnson waves his hand and a dozen ladders move to place, a dozen chain blocks work themselves up, chucks unscrew themselves, tail stocks retreat, carriages get out of the way, jobs rise into place, and oil cans squirt. What share has Paul Johnson in these things going on all around him? What magic is there in that wave of his hand? What kind of clay is Paul Johnson made of, and where was the error in mixing it when John Paul was made? I give it up.

* * * * John Paul's soul was in a constant revolt against awkwardness, clumsiness, ignorance and stupidity. He appeased his revolted soul by doing the work himself with active, intelligent dexterity. What will become of a shop full of men while a too nervous foreman is appeasing a revolted soul with a key drift, or a file, or a lathe, or a hand reamer, or a pipe die, or a crowbar? John Paul never seems to have struck on any successful plan for transferring some of his excellent qualities to his men. He can simply substitute his own excellent labor for theirs.

Considering the fact that John Paul will do about five men's work without knowing it, his mode of operation is not so very bad when he is working only eight or ten men. The smart men do their own work, and John Paul does the work of the dull ones. It takes just so much pay roll to get so much work done.

* * * * But with fifty men is John Paul long enough to reach? Won't there be more pay roll than work? With Paul Johnson it is different. Ten men, forty men, a hundred men, all are the same to him, except that he has trouble keeping engaged when he has but a few men to attend to. Two more men means two more days' work per day to Paul Johnson, and he doesn't do this extra work himself either. I wish I knew how he managed it.

* * * * Paul Johnson is no machinist himself. He don't know how to file anything flat, but he knows how to get flat filing done. If he undertook to file a piece of brass he would not know what was the matter with the slippery thing, and would call for new files indefinitely. But he don't undertake to file brass. If he should screw up a pipe joint it would leak. But he has other men screw up pipe joints and there must be no leaks. If he tried to waltz a ladder through a crowded shop the ladder would get away with him. If he should attempt to reach up and hook a chain block in place, he would break his neck. But there is no danger. He is not a member of the hook and ladder company. He is the chief.

* * * * Another thing Paul Johnson don't do is to be eternally belittling the skill of his men by going over their work. He may test the work, but you can't catch him at it, and the shop turns out accurate work.

* * * * A man working for John Paul puts a line through an engine; along comes John Paul and tests the line with calipers. The man puts a marked stick in the crank pin; John Paul measures the stick. The man rotates the main shaft and squares it by the line; he must rotate it some more, so that John Paul can see if it is square.

A good blacksmith has just hardened a big tap; John Paul will sandpaper it and draw the temper properly. A big shaft is to have shoulders turned at certain spots; John Paul measures and prick-punches, and when the shoulders are turned he measures again to see that no mistake has been made by the lathesman. A shrinking fit is to be made. This is John Paul's sole prerogative of course. John Paul puts on the big belts; John Paul cuts and laces such belts; John Paul has the biggest crowbar when something is to be pried, and he has the heaviest strain when there is a lift. John Paul's mind centers on the thing to be done and neglects all else. A heavy job is to be shifted under a radial drill; John Paul is of course on hand as one of the main shifters. With intent mind, and dexterous bar, and horizontal back, he is doing the work of the entire gang, to the total neglect of his minor end, which the revolving twist drill delights to seize.

Whatever John Paul does, he does properly. He does it properly because he is honestly anxious to see it properly done. What don't he do? What would be done if he didn't do it?

Paul Johnson does no such business as this, and the work is all done, and properly. How does he manage it anyhow?

* * * * A few weeks ago I stood in the top gallant crosstrees of a big beam engine. The cylinder head was to come off, and Hanlon the chief engineer had sent three men up to do the work. Hanlon had half a dozen of these engines under his charge, and plenty of men, but he did nine-tenths of the work done around the engines. He stood by me as his men unscrewed at the thousand-and-one nuts which held the cylinder head on. The work proceeded very slowly as things were hot, positions awkward, and the men a trifle clumsy. I saw Hanlon was itching to go at it himself, but by idle conversation I held him back till about ten nuts had been removed by the three men. I turned my head and when I turned it back again Hanlon had possession of the field. He had cleared all the men away except one to follow him up to remove the loose nuts, and in a jiffy was done with the job. I asked him why he couldn't keep his fingers off, and he said "It hurts me to see things drag." Even so with John Paul.

* * * * One bad thing about John Paul and Hanlon is, that by degrees their men become untrustworthy and absolutely worthless in the absence of their chief.

Certain air valves of Hanlon's engines are articles of consumption. They are bound to give out, and duplicates are always held. Putting new ones in is a somewhat tedious, dirty and undesirable job, but Hanlon is the man who always does the job.

I looked at this as a fault, and Hanlon said, "I have had men put these valves in but they never did it right. There is too much at stake, and I will never trust a man to put one in again as long as I have charge of these engines."

* * * * I asked Hanlon what provision he had made against his absence by sickness or otherwise. He said he couldn't get sick. Had to stay and tend to those valves, or fancied he did. He thought it might be a fancy, but if so it was a very troublesome one. Is John Paul a man of mere fancies?

* * * * *

Very respectfully, Chordal.

of a mechanical nature, which can be quite easily overcome; for nearly every one now recognizes the fact that the indicator is the proper instrument to point out the defects in the working of steam engines.

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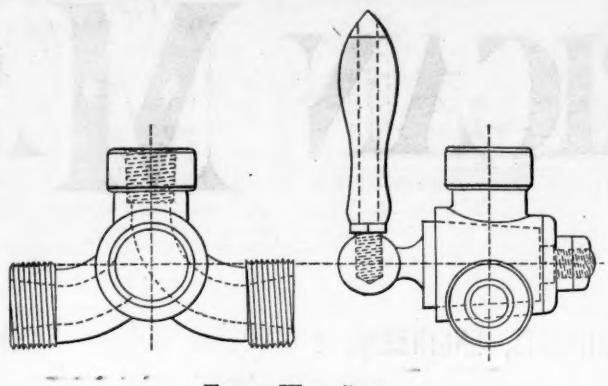
In the first place, the pipes from the cylinder to the indicator were too long, as shown in the engraving accompanying my previous article, and notwithstanding the fact that they were wrapped the condensation was considerable. The pipes entered the cylinder at a point in line with the steam ports, so that the steam in passing and repassing the mouth of the pipes caused wavy lines upon the diagrams.

It has been argued that this method of application makes no difference, but from a comparison of numerous diagrams, taken from an indicator attached as in this case, with others taken from one applied to the same engine under like conditions, to an opening in the side of the cylinder at right angles to the ports, I am convinced that an indicator will give far more reliable results when placed in the latter position, than in the former. Another objection was, the cord being too long and elastic, the stretch of it was plainly shown in the varying lengths of the diagrams taken at high speeds. The indicator rig shown in the accompanying engraving is very simple, inexpensive, and is capable of being applied to all kinds of modern outside connected locomotives, and may be used upon several styles, having inside connections.

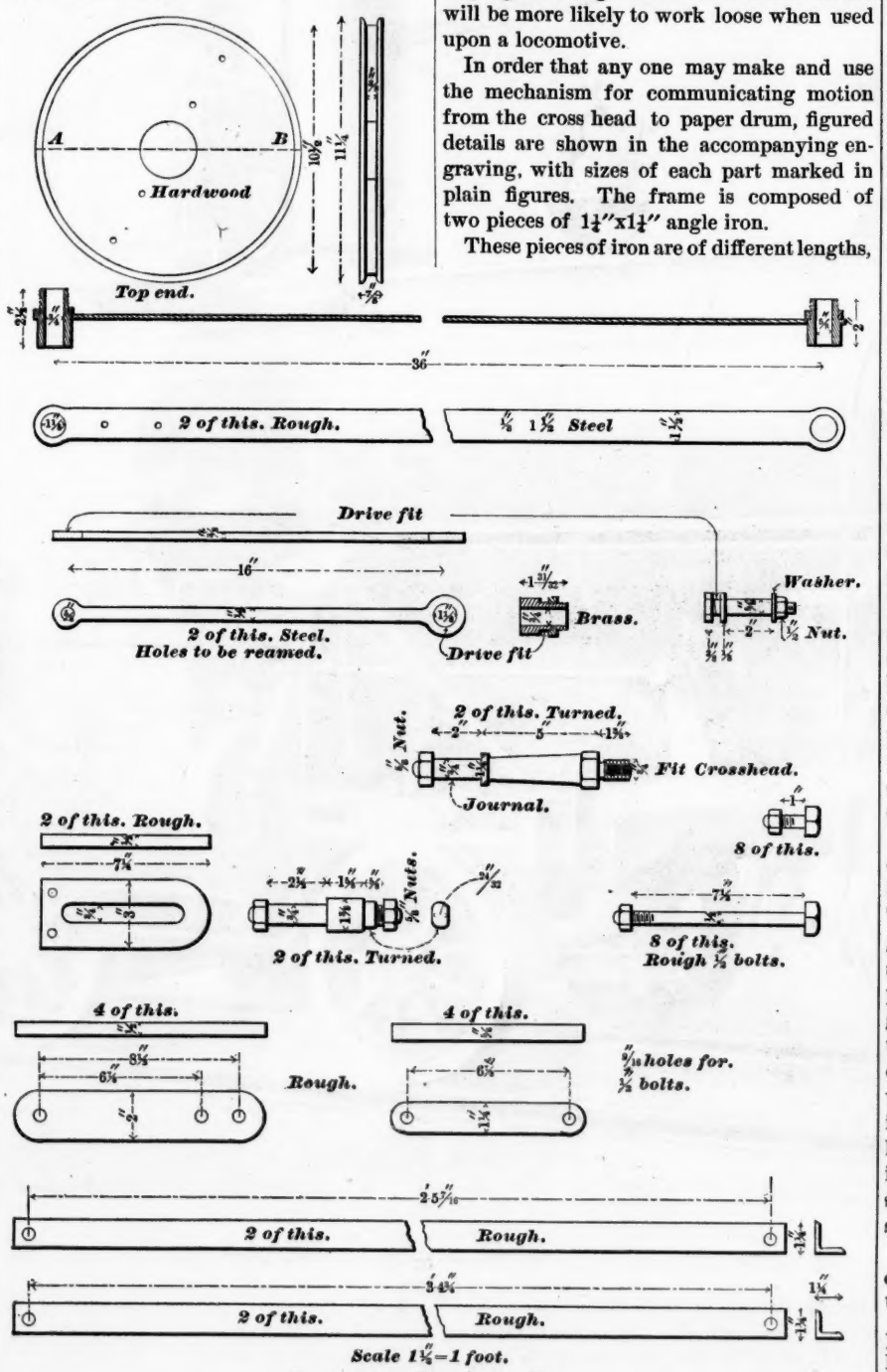
For making connections with the cylinder, a hole is drilled close to the flange at each end and tapped to fit a ¾″ nipple (wrought iron pipe). These holes should be so drilled as to clear the bore of the cylinder, so that the piston may not cover the holes at the ends of the stroke. In some instances, where the counter bore is but little larger than the diameter of the cylinder, a passage should be gouged from the clearance at the end to the hole communicating with the instrument. This is a necessary precaution, so that there may be no obstruction of the free passage of the steam from the cylinder to the indicator. After the holes have been drilled and tapped (which may be done without removing the cylinder casing or back cover), two nipples having ¾″ malleable iron elbows upon the ends, are screwed in place. These should be tightly screwed up, and set looking towards each other.

Upon No. 169 one edge of the holes just touched the offsets formed by the ends of the bore of the cylinder, while upon the opposite sides the nipples just cleared the cylinder flanges. Two long nipples, having brass collars brazed upon one end, are then cut of a proper length to fill the space between the elbows and cock. Brass should always be used for the collars as spelter solder will not run through the threads if the collars are of wrought iron. The end of one of these nipples is to be cut in the usual way and tightly screwed in place while upon the other nipple the die is run up 1½″ for the application of a lock nut. It is then screwed into the elbow, the three way cock is put in place, the joints being made with washers of annealed sheet copper. Rubber and all other fibrous material causes trouble when used for making these joints. The nipple having the lock nut is screwed out from the elbow until the joints are firmly made upon the cock, then the lock nut is to be set up against the face of the elbow, a few strands of lamp wick having previously been wound between the two surfaces to avoid any possibility of leaks. The ends of all the pipes should be carefully rounded inside with a file, and nothing but clean oil should be used in making the joints. If red lead is used, the operator, in taking the diagrams, will have the dissatisfaction of seeing his instrument stick, and will be obliged to remove the piston frequently and pick the lead and dirt out of the instrument.



Three Way Cock.

The three-way cock, shown on this page, is of a pattern I had made to suit my taste. There is plenty of metal used in the shell, the advantages of which will be readily appreciated by those who have used plug cocks having thin shells. The brass center of the handle has a wooden covering, which protects the hands from being burned. The passages are quite easy and of large diameter —$\frac{9}{16}$″ in this case.



Details of Indicator Rig.

The top of the cock is tapped for half-inch pipe, which fits the stop cock for the indicator. I use collars in making pipe joints against each end of the cock, preferring that way to the one in which a stuffing box is made in one end of the cock.

If the pipes are put up properly, there will be no trouble caused by the difference in expansion between the pipes and the cylinder of the engine. The washer upon the plug has a square hole through it, in which a square groove is turned opposite the edge of the shell.

A brass ring is turned to fit the groove, a steel pin is placed in the end of the shell, and a section of the brass ring is cut out sufficiently to allow the plug to be turned, so as to open the cock for both ends of the cylinder. After marking in place, the ring may be permanently fastened by sweating with soft solder.

This form of stop is very easily made and works satisfactorily, besides it does not interfere with grinding in the plug; jam nuts of 22 threads to the inch are used upon the end of plug, as a single nut with a coarse thread will be more likely to work loose when used upon a locomotive.

In order that any one may make and use the mechanism for communicating motion from the cross head to paper drum, figured details are shown in the accompanying engraving, with sizes of each part marked in plain figures. The frame is composed of two pieces of 1¼″x1¼″ angle iron.

These pieces of iron are of different lengths, and have their lower ends bolted to clamps made of ¼″x2″ bar iron held to the guides as shown in the engraving on first page. The clamps upon the inside of the guides are of ⅝″x1¼″ iron, or whatever size will clear the piston gland and cross-head to answer for all the locomotives intended to be indicated.

The blocks placed between the outside of guides and clamps are of hard wood, of a proper length to bring the lever in line with the pitman. The top ends of the frame are bolted to a slotted plate of ¼″x3″ iron. This plate is placed outside the frames, same as the clamps. The plate here shown is for locomotives having from 22″ to 24″ stroke. If a greater range is desired this plate must be longer and the frames shorter. The reason is that the upper end of the lever is suspended from a ¼″ pin fitting the slotted plate, and as the length of the stroke is shorter or longer this pin must be lowered or raised, to equalize the vibration of front end of the pitman above and below the center line of its motion. The lever is made of ⅛″x1¼″ steel, having ends swollen out like eye bars to 1¾.″ The bushings are all of composition, made to drive fits in their places, and are held by nuts as shown. The pitman is of steel, and is 16″ long between centers of bearings. Connection is made with the cross head by means of the stud shown for that purpose. An angle piece of light iron should always be bolted to the cross head to prevent lateral vibration of the lower end of lever. The grooved arcs for the chord are made from cherry or other well-seasoned hard wood with a flat groove as shown.

A wheel should be turned up in a lathe of the shape shown; the hole in the center should fit the end of bushing in order to facilitate setting the same for bolting to the lever.

This wheel, when finished, is to be sawed through the dotted line *A B*. The size here shown will take a diagram 3½″ long upon a locomotive having 24″ stroke. To prevent the frame from vibrating, a rod of half-inch iron, with an eye at one end, is attached to one of the bolts through the running board, while the other end is threaded 4″ from the end, and has a nut placed each side of the slotted plate at the top of the frame, as shown. The stud in the cross head should be long enough to bring the grooved arc in line with the pulleys upon the indicator.

In applying this rig to a locomotive, place the cross head at half stroke, attach the frame to guides, and set the lever exactly at right angles to the guides and screw up all the nuts, being careful to spread the blocks so that the cross head will not strike them. All we now have to do is to adjust the lever vertically, which may be done in the following manner: With a pair of trammels set to the length of the lever, which in this case is 36″, describe an arc, and draw a straight line 24″ long, with the ends touching the arc. Measure from the center of the line to the arc, which in this case will be about 2″, and set the center of the lower pin in the lever half this distance below the center of the cross head, then tighten the nut on the upper pin. This will equalize the vibration, so that at the ends of the stroke the bottom end of the lever will be one inch above the center of cross head.

This laying out may, and should all be done beforehand, and the distances put down in a book for reference, so as to avoid delay. To prevent the chord from getting out of the groove, a wire loop should always be used, as shown. This rig, as will be seen, can be applied and adjusted without moving the engine. The indicator chord is very short, and the pitman connection quite long. The chord I use is the best-braided linen line, well stretched and lightly waxed. The box is plain, the bottom of which is held 9″ below the bumper beam by a ¾″ bolt through it and the flag stand, while the back end is supported by an iron bracket attached to the stud in the center of the cylinder head.

The counter is the same as used on former occasions, and is attached to a board bolted to the front brace, as shown.

In applying an indicator to the steam chest, I drill a hole in the center of the steam chest horizontally and vertically, then screw in a half-inch nipple and elbow, and set up my indicator in line with the grooved arc. The chord connection to this instrument will be very short.

Holes should be drilled in every cylinder while the engine is in the shop, and brass plugs, with hexagon heads, screwed into them. The cross heads, if not already drilled and tapped, as many of them are, should be, so that upon an hour's notice the indicator rig may be attached without the necessity of cutting the engine, or doing any carpenter work. In cold weather it is a very easy matter to erect a screen to protect the operator from the wind.

All are welcome to the ideas herein advanced, and it is hoped that, by removing existing objections, the advantages to be derived from indicating locomotives will be practically realized and appreciated by master machinists generally.

Comparison Between High and Low Speed Engines.

BY CHAS. A. HAGUE.

III.

In continuing our comparisons, the question of counterbalancing demands a passing notice. In small, fast-running engines it has been found that comparatively heavy reciprocating parts conduce to smoothness of action, and this without any particular efforts at counterbalancing. It being desirable in such cases to carry pretty high pressures, to enable a small engine to do heavy work, the shock of admission is met by the momentum of the moving mass, thereby preserving the connections from jar, but not preventing the reaction of the inertiæ from being transmitted to the framing to a certain extent; and when the steam lead is correctly adjusted the effect is satisfactory. But if, from wear of the valve gear, or from any other cause, the necessary conditions are not maintained, the engine after being in service awhile is very likely to pound at the centers. This, in a motor of from 20 to 50 horse power would probably not be of very great importance, but in an engine developing from 200 to 400 horse power any such irregularity is always expensive, and very liable to eventually prove fatal to the machine.

In some forms of small, high-speed engines, from 20 to 50 horse power, the feature is introduced of completely counterbalancing the reciprocating parts; that is, of placing a counterpoise in the revolving parts, whose momentum at the two extreme positions in the orbit of revolution, situated in the engine center line, just compensates for the inertia of the piston and connections in the opposite direction. In other words, the centrifugal force of this counter-weight in one direction is just equaled by the centrifugal force of the reciprocating parts, at the instant they are passing the center, in the opposite direction, and at this instant these parts present the same effect as though they were a mass simply secured to the crank pin. If this machine should be *driven* by a belt upon the balance wheel, it is reasonable to suppose that these two momentums or forces would counteract each other, and that at the point where these moving masses were held to the framing of the machine—that is, at the journal of the main shaft nearest the crank—equilibrium would be secured in the direction of the engine center line; and thus no tendency of the machine to vibrate endwise would manifest itself, other than the slight effects due to the different velocities of the reciprocating parts resulting from the angularity of the connecting rod. Although equilibrium is established at the main shaft journal, it is at the expense of the crank pin. For the opposing efforts of these opposite forces would be expended upon the point of connection between the two masses producing the forces; and although the framing—which should be heavy enough, by the way, to sustain any amount of shock and strain that it would pay to have the engine undergo—is saved from worrying its fastenings, although the largest and best-supported journal in the engine is relieved from the strain and friction that it is better calculated than any other to bear, the crank pin, one of the most vital and tender parts of the entire machine, is moving with extraordinary velocity under great pressure, and this pressure, at the instant of passing the center, is exactly at right angles to the movement of the pin.

Again, when the counterpoising weight passes the point in its orbit situated in a line at right angles to the engine center line, there is nothing to prevent the loss from frictional power due to the angular velocity of the main journal surface, multiplied by the friction resulting from the centrifugal force in pounds, of the counterpoise *less* the dead weight resting in the bearings, in one direction, and the product of the friction of the centrifugal force *plus* that of the dead weight in the opposite direction. In other words, when we make a small engine, and run it fast to produce power equal to a large one running slow, what is saved in friction, by reason of light weights, is most probably lost again through the effects of increased inertia, as forces pertaining to momentum and velocity increase as the square of the speed, while those pertaining to weight mainly, directly as the weight. In one form of horizontal high speed engine, the peculiar construction is such that the upward inertia of the counterpoise is entirely overcome by the amount and available distribution of the weight resting upon the main journal bearings, but this only results in so much additional pressure when the forces tend downward.

In the construction of this particular form of high speed motor just referred to, the arrangements are peculiar, and of a character that awaken our conservative faculties when the idea is suggested of embodying its principles in engines of considerable power. Setting aside other considerations, among them the employment and risk of four pressed fits instead of two, this complete counterbalancing feature in large engines would be likely to give trouble. We have already remarked upon the probable balance of centrifugal forces if the machine should be *driven* instead of being itself the driver, but when steam is introduced into the cylinder, and especially when excessive compression is employed, there seems to be a chance of interfering with the balancing effect by resisting the inertia of the reciprocating parts near the ends of the stroke, leaving the centrifugal force of the counterpoise without a direct balance; this effect, however, in small engines is not particularly noticeable. Through the medium of the suddenly compressed steam, the moment of inertia is transferred from the reciprocating parts to the cylinder head and thence to the frame, but the force of the counterpoise in the crank is in the opposite direction, and of just equal intensity if the entire force of the reciprocating members has been transmitted, thus throwin g the reversing strain into the framing and against the main journal at the side nearest the counterpoise, but it saves the anchor bolts and foundations, and somewhat relieves the pressure upon the crank pin.

Now, with small engines, wherein the total effect of these forces is comparatively insignificant, any disturbance in the equilibrium by means of the elastic cushion interposed by the compression, is of little account; but when it is realized that very heavy masses, moving with great velocity in large engines, must be *very* nearly coincident in their effects to prevent shocks and jars, likely to prove sufficiently damaging to overbalance all our apparent gains, we are admonished to look very carefully before leaping to a conclusion.

Extracts from Chordal's Letters.

DIFFERENT KINDS OF FOREMEN.

Mr. Editor:

* * * * I actually believe that all the immense amount of rushing work now being done is done by fifty per cent. of the men employed on the work. Certain elastic workmen feel every change in times. When things are dull and but few hands working, the special ones of the few will do less in a given time than the balance. When things boom and the shop fills up, these chaps get enthusiastic and pitch in and do the work, and they keep doing it. Their rise in spirits is the only thing tending to keep up the average performance.

* * * * Priceless is the enthusiastic boss who can keep his hands off things. The temptation to take a dull-headed man's work out of his blundering hands is a strong one, but it must be resisted, or the boss sinks into a mere improver of a single blunderer's work, and as such is worth per day just the increase effected in one man's work, and no more.

* * * * John Paul was a foreman in a machine shop, and had charge of about a dozen men. Wherever you would find this foreman, John Paul, you would find a machinist standing close by watching John Paul do the work.

John Paul was a splendid workman and a good worker, but he did not know how to pick out good men, or how to make good men out of indifferent ones.

An extra heavy job had to go into a lathe. John sends Jim, a laborer, after a sixteen-foot ladder. In comes the end of the ladder, ubiquitously hitting everything in the shop, followed at half stroke by Jim, the clumsy, who carries it. Why should not Jim be as able as any one to engineer a ladder into and through a machine ship? He has been superintendent of that ladder for months, but has never been able to improve its running time. John Paul, with an impatient mutter, with eye and mind on the spot where he wants the top of the ladder to go, takes two quick strides, snatches the ladder from Jim, and, with one free, perfect, thoughtless movement, plants it in exactly the right place. I question if he thought of the process or of the ladder. He saw only the place up there. There is an eyebolt, close up to the flooring, between two joists. He tells Sam, the big lathesman, to go up the ladder with the chain block. Sam fusses with the hook and strains himself, works clumsily at arm's length, and runs his tongue out of the corner of his mouth, blows the dust out of his eyes, and wears himself out and gets shaky. John Paul twitches impatiently, for the thing is tiring him as much as Sam. He calls Sam down, takes the block up the ladder, hooks it in place and comes down again. Why could not Sam do a little thing like that as well as John Paul? Then there's a sling to rig up, and a chuck to take off at the eleventh hour, and a dog to get, and a tail stock to set, and a carriage to be run out of the way, and a tug on the chain, and a steering of things, and an oil can to get, and a center to oil, and a final and finishing screwing up of the center when the job is in place. Who does most of all this? The six men standing around? John Paul does it.

* * * * Do the men shirk? Not a bit of it. They pester John Paul by their abortive willingness. Then why does John Paul do this work? Another question too hard for me.

* * * * John Paul's brother-in-law, Paul Johnson, is a boss, too, and works fifty men. No ladders, or blocks, or chucks, or oil cans in his labor. He gives his orders and behold, the work is done as though he had an army composed of John Pauls working for him.

John Paul can only push one thing at a time. Paul Johnson waves his hand and a dozen ladders move to place, a dozen chain blocks work themselves up, chucks unscrew themselves, tail stocks retreat, carriages get out of the way, jobs rise into place, and oil cans squirt. What share has Paul Johnson in these things going on all around him? What magic is there in that wave of his hand? What kind of clay is Paul Johnson made of, and where was the error in mixing it when John Paul was made? I give it up.

* * * * John Paul's soul was in a constant revolt against awkwardness, clumsiness, ignorance and stupidity. He appeased his revolted soul by doing the work himself with active, intelligent dexterity. What will become of a shop full of men while a too nervous foreman is appeasing a revolted soul with a key drift, or a file, or a lathe, or a hand reamer, or a pipe die, or a crowbar? John Paul never seems to have struck on any successful plan for transferring some of his excellent qualities to his men. He can simply substitute his own excellent labor for theirs.

Considering the fact that John Paul will do about five men's work without knowing it, his mode of operation is not so very bad when he is working only eight or ten men. The smart men do their own work, and John Paul does the work of the dull ones. It takes just so much pay roll to get so much work done.

* * * * But with fifty men is John Paul long enough to reach? Won't there be more pay roll than work? With Paul Johnson it is different. Ten men, forty men, a hundred men, all are the same to him, except that he has trouble keeping engaged when he has but a few men to attend to. Two more men means two more days' work per day to Paul Johnson, and he doesn't do this extra work himself either. I wish I knew how he managed it.

* * * * Paul Johnson is no machinist himself. He don't know how to file anything flat, but he knows how to get flat filing done. If he undertook to file a piece of brass he would not know what was the matter with the slippery thing, and would call for new files indefinitely. But he don't undertake to file brass. If he should screw up a pipe joint it would leak. But he has other men screw up pipe joints and there must be no leaks. If he tried to waltz a ladder through a crowded shop the ladder would get away with him. If he should attempt to reach up and hook a chain block in place, he would break his neck. But there is no danger. He is not a member of the hook and ladder company. He is the chief.

* * * * Another thing Paul Johnson don't do is to be eternally belittling the skill of his men by going over their work. He may test the work, but you can't catch him at it, and the shop turns out accurate work.

* * * * A man working for John Paul puts a line through an engine; along comes John Paul and tests the line with calipers. The man puts a marked stick in the crank pin; John Paul measures the stick. The man rotates the main shaft and squares it by the line; he must rotate it some more, so that John Paul can see if it is square.

A good blacksmith has just hardened a big tap; John Paul will sandpaper it and draw the temper properly. A big shaft is to have shoulders turned at certain spots; John Paul measures and prick-punches, and when the shoulders are turned he measures again to see that no mistake has been made by the lathesman. A shrinking fit is to be made. This is John Paul's sole prerogative of course. John Paul puts on the big belts; John Paul cuts and laces such belts; John Paul has the biggest crowbar when something is to be pried, and he has the heaviest strain when there is a lift. John Paul's mind centers on the thing to be done and neglects all else. A heavy job is to be shifted under a radial drill; John Paul is of course on hand as one of the main shifters. With intent mind, and dexterous bar, and horizontal back, he is doing the work of the entire gang, to the total neglect of his minor end, which the revolving twist drill delights to seize.

Whatever John Paul does, he does properly. He does it properly because he is honestly anxious to see it properly done. What don't he do? What would be done if he didn't do it?

Paul Johnson does no such business as this, and the work is all done, and properly. How does he manage it anyhow?

* * * * A few weeks ago I stood in the top gallant crosstrees of a big beam engine. The cylinder head was to come off, and Hanlon the chief engineer had sent three men up to do the work. Hanlon had half a dozen of these engines under his charge, and plenty of men, but he did nine-tenths of the work done around the engines. He stood by me as his men unscrewed at the thousand-and-one nuts which held the cylinder head on. The work proceeded very slowly as things were hot, positions awkward, and the men a trifle clumsy. I saw Hanlon was itching to go at it himself, but by idle conversation I held him back till about ten nuts had been removed by the three men. I turned my head and when I turned it back again Hanlon had possession of the field. He had cleared all the men away except one to follow him up to remove the loose nuts, and in a jiffy was done with the job. I asked him why he couldn't keep his fingers off, and he said "It hurts me to see things drag." Even so with John Paul.

* * * * One bad thing about John Paul and Hanlon is, that by degrees their men become untrustworthy and absolutely worthless in the absence of their chief.

Certain air valves of Hanlon's engines are articles of consumption. They are bound to give out, and duplicates are always held. Putting new ones in is a somewhat tedious, dirty and undesirable job, but Hanlon is the man who always does the job.

I looked at this as a fault, and Hanlon said, "I have had men put these valves in but they never did it right. There is too much at stake, and I will never trust a man to put one in again as long as I have charge of these engines."

* * * * I asked Hanlon what provision he had made against his absence by sickness or otherwise. He said he couldn't get sick. Had to stay and tend to those valves, or fancied he did. He thought it might be a fancy, but if so it was a very troublesome one. Is John Paul a man of mere fancies?

* * * * *

Very respectfully, CHORDAL.

A New Belt Tightener.

In lacing large belts it is absolutely necessary to have some device for clamping the ends together. Since any accident to a belt that calls for the stopping of all, or a portion of the machinery of an establishment, usually has the effect to keep a number—sometimes a large number—of men idle, it is evident that any means that shall expedite the work is a matter of considerable economical importance.

The ordinary device in use for this purpose is the old-time wooden clamp, which, with its clumsiness and generally unhandy features, is expensive, in that it costs so much in the time and delay in its use.

The accompanying engravings represent two views of a belt-tightener, manufactured by Sweetland & Co., New Haven, Conn., the object being to provide a cheap and effective device for the purpose. As will be seen, it consists of four cast iron blocks, which are each provided with a clamping jaw, between which and the block the two ends of the belt are held. These jaws are provided with clamping bolts, by the operation of which they are made to grip the belt, and the jaws are held away from contact with the belt by light springs, which are compressed by the bolts as they are screwed down, and when loosening to remove the clamps they materially assist, by forcing the jaws away from contact. These springs also serve a useful purpose in holding the jaws at all times in a position to be easily adjusted.

Rods of suitable length and size connect the blocks together, thereby preventing them from twisting while tightening the belt, which is done by means of the right and left hand screws, as shown. To accommodate different widths of belt the blocks are clamped in any desired positions on the rods by means of thumb-screws.

It will be seen that this belt tightener has great capacity, and is almost instantly adjusted to any width of belt, being limited only by the length of the rods that connect the clamps; also that upon whatever width of belt used the clamp jaws are always in the best possible position to hold the belt. The right and left hand screws, by the operation of which the belt is drawn together, are of sufficient length to allow the clamps to be placed at such a distance from the ends of the belt as to leave ample room for lacing, or for applying a square to the ends, if desirable.

Each of the clamps are applied separately, and when advisable the belt may be passed over the pulleys with the clamps attached. In using in places where the space is narrow, the ends of the belts, with the clamps attached, can be separately turned in a direction to afford the most room for applying the rods, after which the screws are put in place. This makes the device convenient for use where there is but little room.

The nuts used in connection with the tightening screws are held loosely in the block, and are so arranged that they will accommodate themselves to the alignment of the screws should one side of the belt be drawn up faster than the other, in tightening.

It is the little things that fret and worry us, A three-year-old boy may keep a man in perfect misery, whereas no such trials would accompany the presence of his eighteen-year-old sister.—*Philadelphia News.*

In 1881 there came to the United States 720,045 immigrants, which is about 126,000 more than ever arrived in any one year before. In January, 1882, 18,489 immigrants arrived, against 18,134 during the same month of 1881.

The cotton factories of Columbus, Ga., give employment to 2,589 hands, use 17,880 bales of cotton annually, and have a capital of $1,968,000.

West Virginia produces nearly one quarter of all the nails made in the United States.

The Massachusetts House of Representatives is to be lighted by electricity.

Moulding Large and Small Pulleys.

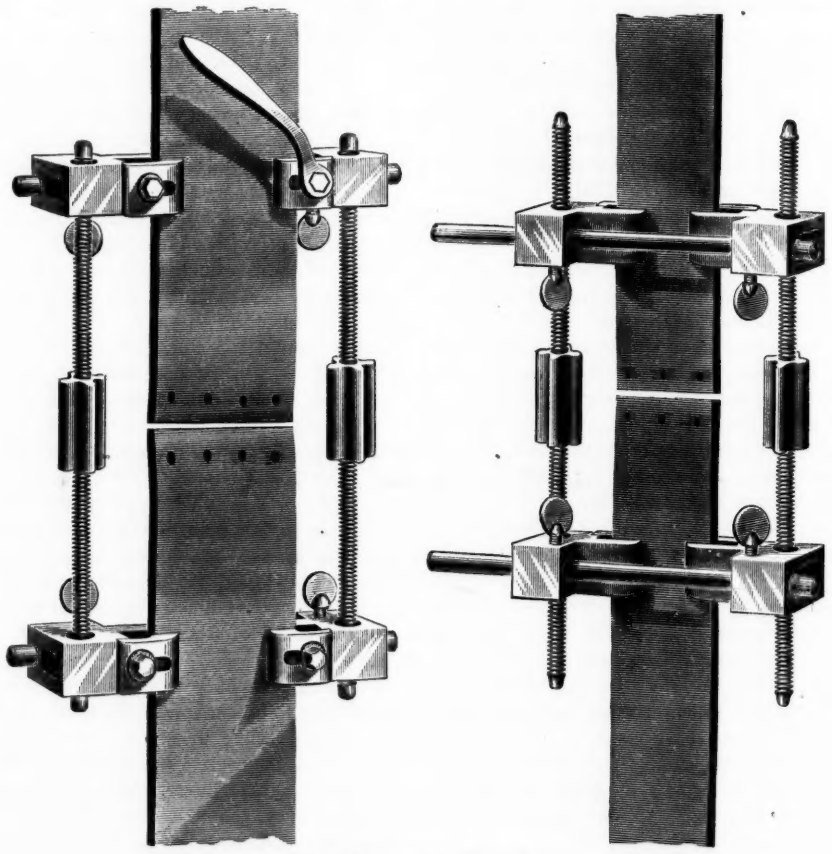
By Thomas D. West.

When making pulleys of various sizes, a shop should be supplied with as good patterns and rigging as possible. In making small pulleys, the work he can do in a day depends more upon the convenience of the rigging than upon the man. In moulding large pulleys some firms have full patterns, but for a special size, or when there is only one or a few to make, the sweep and core box is used to save pattern making. For very large pulleys with double arms these are necessary.

The cut on page 5, showing sweeps, brick work, and half section of mould, having two sets of arms formed with dry sand cores, represents different modes of sweeping or moulding pulleys. By the use of this rigging, pulleys from five to twenty feet diameter, and of any width of face required can be moulded. For forming the outside face, there are two ways shown. One is by using the sweep *X*, and the other by using a segment, the elevation of which, and a hook for drawing the pattern, are shown at *B*. With this segment the outside can be moulded either in green or dry sand. To mould with dry sand there would be required an iron bottom ring and cheeks, or side flasks. After it is all rammed, hoist the outside off by handles on the bottom ring, or plate. The mould can then be blacked and run into the oven to dry. The sweep can be used either for green or dry sand, as well as for loam. If the mould is swept up with loam, or dry sand, it is better if possible to hoist off, and should the oven not be large enough, it could be drying on the floor while the inside of the pulley is being moulded. *O*, shows the stakes driven down alongside of each handle to guide the outside off and on. The four plates, one of which is shown under the lifting ring, are to insure a good bearing for the outside to rest on, should the sand joint be disturbed by walking on, or otherwise when sweeping the inside.

When sweeping with green sand, a hole is dug in the floor to about the depth of face required, and a wooden curb, or a piece of boiler iron, is used as a support for ramming the sand against, so as to make it solid. After this the sweep can be worked around to form a true face, which can be made crowning or straight as desired.

When swept up with loam, the outside of the pulley can be made smooth and true, so as to save turning up in the machine shop, if so desired. For very large pulleys this is worthy of consideration.



New Belt Tightener.

When moulding the inside of a pulley, the same principle is involved, whether there are one or two sets of arms. The double sets make the moulding more complicated and risky, but in the hands of a good moulder there is little danger.

There are two ways of making arms; one is with dry and the other with green sand cores. The making of the inside will depend upon whether the outside of the pulley is formed with the segment, or with the sweep. Should the segment be used, the inside of the pulley, when the arms are formed in dry sand core as shown, will require to be moulded first, so as to have a bearing for the segment to be rammed against. When the arms are made in dry sand cores, the cores should not be made any larger than is required to give them a body sufficient to be handled with safety.

The cut shows one core resting on the bottom level bed, which is formed with a sweep. There is a projection on the upper side, and also one on the top arm core, so that when both come together they make a hub formed of dry sand cores, and the space between the upper and lower core is filled with green sand. The inside is also rammed and formed with green sand wherever the arm cores do not fill up.

When the face of a pulley is wanted more than three feet wide, the arms would come so far apart as to make one continuous hub, very heavy, unless the center core should have a deep chamber to take out as much weight of iron as possible. Should the hubs be wanted separate, they can be made so by using a flat covering and bottom cores, the same as shown at *H, H,* for forming the bottom and top of the hub shown. In order to let the iron run from the top hub down and into the lower one, there can be risers or flow gates connecting the two as shown at *A*.

The arm core box *P*, is used for forming the hub, arms and inside face of the pulley with all green sand. The depth of the box is made the same as the face of pulley wanted, and is spaced off according to the number of arms required.

A double set of arms can be made with the green sand cores, with almost the same surety, that a single set can, providing the face of the pulley is not too deep. There could be two sets of cores made, one being on top of the other.

The green sand cores could not be used with safety when the segment is used for forming the outside, nor would it be practicable to attempt to use the double set of cores unless the outside of the mould was made so that it could be hoisted off, and out of the way, as in the plan of the brick-loamed mould shown. Then set the green sand core, using for your guide a mark made on the bed with the core sweep *W*. When the bottom set of cores are placed on the bed, the upper set of cores can be placed on top of the lower ones without any trouble. In this way it can be seen if there is any crushing, and the joints of the cores can be made up so that there will be no fins on the casting. This core sweep, *W*, is also used for giving form to the green sand that is rammed between the dry sand cores, when they are used to form the arms as shown.

To make the neatest looking pulley casting, the green sand arm cores are the best when they can be used with safety, for when a casting is made of part green and part dry sand, loam, or cores, each will leave its own trade mark on the casting. The green sand part will swell more or less, according to the pressure of iron when the mould is being cast, but the dried part of the mould will not swell, so when the casting comes out it will have an uneven surface. The different colors of green and dry sand, loam or cores, on a casting make it look bad; as if it had been made in sections. There are several ways to make a covering for the top of the rim and hub, also arrangements for bolting or weighting down. The first is to have a level dry or green sand cope; the second, a loam plate, and the third to make some cores to cover the rim, as shown covering the hub at *H*, and have a cast iron flat plate to lay inside of the covering cores on top of the sand, or cores, that form the arms and inside of the pulley. This plate is used to lay the weights on to hold down the inside part of the mould when being cast. To hold down the covering cores, small weights are used. Sometimes the rim is cast all open, and the hub and arms, or inside, are the only parts weighted.

The gating or pouring of such castings is generally done (if the center core is large enough) through the center of the core to gates cut into the bottom of the print, so that the iron fills up the mould by coming in at the bottom of the hub; or by dropping the iron through runners from the top, as shown at *A*. The iron spindle shown, when used for sweeping large pulleys should be held at the top by a brace stretched across the mould, and fastened to two upright timbers sunk into the floor 3 or 4 feet away from each side of the mould. If near enough to the side of the building, there could be a swinging arm made to reach out to the spindle, to hold it firm and steady.

The arm pattern in the core box *P* is set into the middle of the outside frame, and after the core is rammed up and ready for the box to be drawn, by hitting the arm at the end *R*, to start it, the pattern can be pulled out easily through the hub end *D*; after which the outside box can be taken away.

In making these cores, a cast iron beveled edge plate the shape of the inside of the box, and made so as to have about $\frac{1}{4}$" clearance all around the inside, is set on a level board, or a hard bed of sand. The box is then set on, and the core rammed up nearly to the arm, which is then put into the box and the sand tucked under it even and firm. At this point, the moulder must be careful, as in making the cores in this way, the arm can not be got at to finish it, or to fill up soft places after the core is made. The advantage of making a core in this way is, that when setting in the cores there is no danger of crushing the arms, or of having fins on them, which must be chipped off when the casting comes out, which is likely to be the case when one-half is formed at the outside surfaces of the core, *T T*. To lift or hoist these cores, there can be lifting hooks, or nuts cast in the anchor or lifting plates, the lifting hooks being made so as to come up even with the top of the core. When nuts are used, long screws, as shown at *E E*, are used, and when the first core is set in the mould they can be taken out and used for the others.

The cuts 4 and 6 show the plan of making pulleys with a draw-ring pattern. In this way any face required can be moulded from the same pattern.

At 6 is shown the mode of casting a pulley having a face wider than the pattern. In moulding this a hole is first dug in the floor and the ring pattern set in, beveled and rammed up to about the center of face required. The loose arm and hub are then bedded in as shown. The dotted lines show the distance the ring pattern has to be drawn, in order to have the arms in the center. The pulley can be cast with the rim open, or covered with a cope, as desired. It is best to make the faces about ½″ higher than wanted, so as to give stock for the machinist to true up.

The hub shown is arranged to readily change the core prints to any size wanted. The hubs have a hole drilled through their centers, the same diameter as the holes in the center of the arm pattern, and there are wooden plugs driven into the hubs which project on the side or face that comes next to the arm, and centers the hub. The core prints have also projections turned on them the same diameter as the hole in the hubs, so that a moulder working on pulleys need not be running to a pattern maker every time he wants to change the size of prints.

At 4 is shown two ways of making the anchor or lifting plates. One style has a wrought bent rod cast in them, reaching from one plate to the other. The second plan is to have a cast iron rib reach from one to the other—a plan I adopted, and find it to be more reliable and to make a stiffer plate than the wrought iron rods. The oval, black spots represent the arm between the plates.

When a double set of arms are wanted in smaller pulleys, there are a number of ways they can be moulded, but as a general rule foundries do not rig up to make double arms, there being so few ordered. When one is wanted, the rigging is got up with as little labor as possible. In some instances, the lower set of arms is made with cores, or a flat core is made inside the ring pattern, having one half of the arms and hub formed in it, and the other half is bedded in green sand. Before the arm pattern is drawn the flat core is set over the arms and staked through holes made in the core between the arms. The core is then taken out and the pattern drawn, after which the arms are finished and the core set back. The pulley is rammed up to where the upper arms are wanted, and the rest of the moulding is the same as in making a pulley with one set of arms. Another way of making the lower set of arms, is to have single cores with half the arm and hub formed in them, and when the arm pattern is drawn the single cores are placed back, guided by stakes or sand marks made by laying the core on top of each arm before the pattern is drawn.

Although using the cores as described is a quick way of forming the lower set of arms, it does not produce as good looking casting as when they are formed by the following plans. In some cases foundries have used a regular anchor plate for the bottom set of arms, and when the castings come out the anchor plate had to be broken in order to get it out of the casting. When there is time to make the rigging, loose plates having nuts for screws, or lifting hooks cast in them, are used. These plates are set between each arm, and the pulley rammed up 6″ or 7″.

A plate having holes to correspond, so that the screws or hooks can pass up through and be wedged, is bedded on the sand. The pulley pattern is then drawn and the flat plate having all the loose plates wedged up to it, is hoisted out. The arm pattern is drawn and the core lowered back, after which the pulley pattern is gently set back. The wedges are now loosened, the flat plate taken out and the upper arm and the rest of the pulley is rammed up and finished.

Another way is to have holes in the upper anchor plates, and by having two sets of arm patterns, ram up the whole pulley. Long bolts with threads cut on each end are used to bolt the lower loose plates to the top lifting plate, by which the whole core is hoisted out and the lower arm finished. The core is then lowered back, and the nuts taken off. The top portion is then hoisted out and the upper arm finished. The bolt holes in the sand are enlarged and the top portion lowered down to its place.

The following dimensions are from what is termed a light, a medium, and a heavy set of pulley ring draw patterns, from 10″ up to 48″ in diameter. The face of these patterns

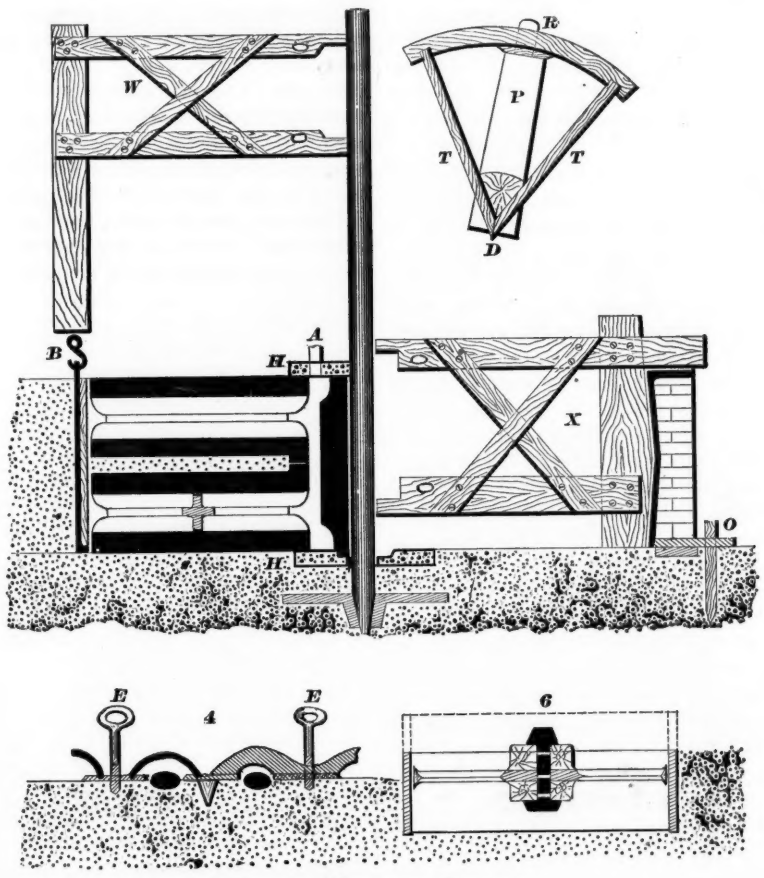
Diameter.	Thickness.
LIGHT.	
10″	7/32″
48″	14/32″
MEDIUM.	
10″	9/32″
48″	16/32″
HEAVY.	
10″	11/32″
48″	18/32″

generally runs from six to ten inches, and to draw them, holes are drilled through the pattern within 5/8″ of the top, and hooks instead of screws are used. In making a set of these patterns they could be swept up in loam, or in green sand, by using a segment attached to an arm having a hole at the radius wanted, to fit on a stake driven into the sand; or the arm could be attached to an iron spindle.

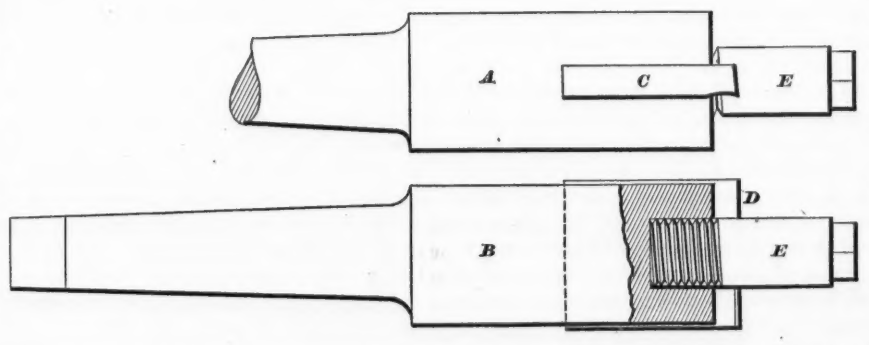
There are some things that a foundryman should think of before starting to make a set of draw patterns. One is, that a poorer grade of iron, can be run into heavy pulley castings than into light ones. Should a No. 2 iron, that can be turned in a heavy pulley, be run into a light one, he might be looking for cracked arms, or a blessing from the machinist that tried to turn them. Where competition is sharp it is best to have a light and a heavy set of patterns, so that customers can have their choice; but if you can make them believe that a heavy pulley will wear longer, it will be more money in your pocket. When an establishment intends to make nothing but pulleys, it is better to be fitted up with what are called split pulley patterns, which require a pattern for every width of face wanted. They should also have the best of flasks to make them in, by which means they can be made very fast. But for the jobbing foundry, the draw patterns are the best, as fewer patterns and flasks are needed, and the expense is nothing compared with the cost of getting up a stock of split patterns, and the necessary flasks.

For the proportion of either straight or crooked arms, there can be found full figures given by Chordal, in the American Machinist, July 23, 1881.

As regards the shrinkage, or cracking of pulley arms, I will leave the discussion until some future time, but will say here that, to prevent the arms cracking select iron having the least possible shrinkage. In my practice, when there is a car of No. 1 iron comes to the shop, I always test it by melting one charge in the small cupola. At the second tap I catch a hand ladle full and pour a 1″ square bar 5 feet long, and when cool, should the bar have shrunk more than ½″, there will be danger of light rim pulleys cracking if made from it. To determine if soft when remelted, I have some poured from the same hand ladle, into some little test moulds, having one side of the mould formed with an iron chill, and when cool the pieces are broken and tested.



Rig for Moulding Pulleys.



LETTERS FROM PRACTICAL MEN.

A Handy Counter-Bore.

Editor American Machinist:

An adjustable counter-bore is a very desirable tool upon many kinds of work.

The accompanying engraving represents two views of a tool that is original with me, and was designed more particularly for wrought-iron work. It may, however, be used upon other kinds of metal.

There are only three parts to this tool, consisting of a steel shank *A B* to fit the spindle of the drill press; a tempered steel cutter *C D*, firmly held by a steel set screw *E E*, which also forms the tit or guide for the cutting edges. Some of the advantages of this tool are that the cutter can be readily adjusted and detached, or it may be replaced by one of a different size.

These and other advantages are appreciated by those who have used them.

Chicago, Ill. N. A. Neilson.

Advice to Apprentices—Making an Apron.

Editor American Machinist:

In my last I gave a little advice to young journeymen. In this I will volunteer a little to apprentices.

The apprentice should cultivate the habit of observing. He should notice how the older and best mechanics do the work they have in hand; how great a speed they give in cutting different materials; how fast they run their lathes on brass, wrought iron, cast iron, steel, wood, and other materials. He should also observe how they dress and grind their tools; how they set them in the lathe, planer, shaper, etc.; how fast they run their drills, and how they grind them; how they fasten work on the planer, and how they chuck it in the lathe; what cutting angle is given to taps, reamers, mills and other tools, and a thousand other things too numerous to mention.

A good practice for the apprentice is to take some machine, as for example, a lathe, observe its construction, and during leisure hours and evenings sketch every part and piece from memory. After so sketching it, take the drawing to the machine and compare it; find out what mistakes have been made; then again (from memory alone) correct the sketch of the part until satisfied with its perfection. Then take some other part and do the same. After the machine has been sketched in detail, assemble the parts in a drawing of the whole. Now take every piece in detail and imagine how the work on it was, should or could be done. To assist in this, observe how good mechanics treat similar work. After a little practice in this line of thought, the apprentice finds himself involuntarily thinking how he would do the work on every part of every machine he sees.

Cultivate a true mechanical eye. Set up a stick against a wall and plumb it by your eye; then test it; do the same in leveling something. Draw lines as straight as you can, then test them with a straight edge. Draw circles as correctly as possible, and test them with a pair of compasses Lay down a quarter of a dollar, or any thing that is circular, mark it out on a piece of paper, center it by your eye and test to see how nearly correct it is done. Take a piece of level board and a piece of pointed straight wire, drive the wire into the board and square it all ways by your eye, then test it with a square. Mark off a straight line on paper, draw another at a right angle to it as nearly as you can, then test your work. Many other examples could be given, but examples will suggest themselves to the apprentice who desires to learn.

Cultivate your sense of size, or distance. To do this, draw a straight line, divide it into inches as nearly as possible by your eye, take a rule and test what you have done. Draw a circle, divide it by your eye into 4, 5, 6, or more sections, then test them with a pair of dividers. Draw two lines, or cut off two sticks as nearly as you can of the same length, then compare them. Such examples can be indefinitely multiplied.

Cultivate your sense of touch, so that you can use a pair of calipers, or a gauge, and be sure of having a fit every time. An excellent practice to obtain this indispensable accomplishment is to take two or three pairs, each, of inside and outside calipers, set them one to the other through the whole number, then compare the first outside with the last inside ones so set.

Cultivate the nerves and muscles of each hand, so that you can use a hammer, chisel, file, wrench or other tool as well with one hand as with the other; or so that you can turn a handle or hand wheel one way with one hand, and another one the other way with the other hand, both at the same time; or as you can turn them both one way or different ways at different speeds. Such

practice in turning handles will be found indispensable in learning to become an expert on the lathe, planer or other machine tool. Practice until the motion of one limb or member is not at all governed or controlled by the motions of another.

Make a wooden model of a file, and use it on a flat piece of wood, until you get so that you can shove a file straight. In doing this, let your thumb rest on the top of the handle. You can never learn to become an expert filer if you rest your forefinger on top. Practice with a hammer and chisel until you can be sure of hitting what you strike at, without looking. Other examples for practice will suggest themselves to the ingenious apprentice.

Study the motions of machinery, and read all of the technical literature you can get pertaining to the trade you are learning. Study arithmetic until you master the fundamental rules; then take up algebra, geometry and trigonometry. If you have an earnest desire to learn, you will find them all exceedingly simple and easy. After you once begin to get an insight, these studies lose their terrors. The difficulties vanish "like frost before the summer sun."

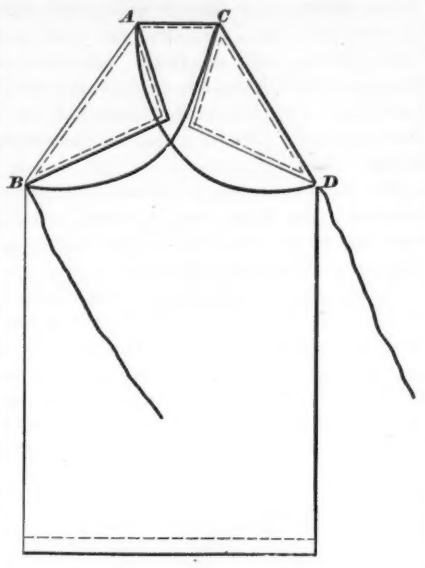
Be always ready to learn something, and make up your mind that no matter how long you live, or how much you study, you can never learn it all. It is only the poor workman who cannot always learn. It can be truly said that the educated only, learn how ignorant they are.

In conclusion, let me say: Be neat and cleanly in your habits and personal appearance. If you are working at dirty work, wear overalls, overshirts, aprons, or whatever may be necessary to keep your clothing clean. There is no excuse for untidiness. I do not believe that I ever saw a really first-class workman who was not neat and tidy in his personal appearance, after he was through with his work, and when he made his appearance in public. If a man is dirty and slovenly himself, he will let his tools get in the same condition, and he is sure to be careless and negligent in his work.

When I worked at repairing old, dirty machinery, or on cast iron, I preferred wearing overalls and overshirts; but when working on brass, wrought iron, steel or wood, I liked best to wear an apron. How to make an apron is an exceedingly simple thing, but there are aprons and aprons. I will show you how I had them made and strung, and, if you do not now use this kind, try one made on this plan, as shown in sketch, and I believe you will never have any other kind made.

I get good, thick ticking, denims, or other suitable cloth, one yard wide, and of sufficient length, so that after the hems are turned it will reach from the neck to within six or eight inches of the floor. Hem the lower end square across, turn the corners down at the upper end, as shown at *A B* and *C D*, so that points *A* and *C* will be at the collar bone, and *B* and *D* at the waist. Then pin on tapes at *A* and *C*, carry them over the shoulders, *crossing* them on the back, and pinning them at the points *B* and *D*, so they are of the right length to draw the apron snugly around the body. Stitch them in permanently. Stitch on tapes at *B* and *D* long enough to pass around the body to the front, and to tie in a bow knot. Put on pockets, as desired. This style of apron will be familiar to most tool makers in the armories, etc. It used to be called a tool-maker's apron, but I doubt if machinists generally have used them. GEO. B. FOOTE.

Helena, Montana.



MACHINIST'S APRON.

Depending on Note Books—A Suggestion on Shop Lighting.

Editor American Machinist:

A great deal of importance has been given by some of your correspondents to the idea of keeping a note book. While note books are very desirable, still it is not well to depend too much on them, but rather to *thoroughly understand the principle* of the thing that is to be kept, in which case it is pretty sure to stay in the memory.

I remember a high-toned young man, who worked in a high-toned shop. He had some scheme in his note book to tell him how to set a Brown & Sharpe milling machine for spirals. It wasn't necessary to understand *why* he did it, because he had his note book, you know. One day this young man "accepted a leading position" in a country shop (which, being translated, means that he got another job), and the first time he took hold of a Brown & Sharpe milling machine he couldn't find his note book, and one of the ignorant countrymen, who never saw a high-toned shop, or a note book, had to set the machine for him.

In your last paper you call for results of experience in shop lighting, where gas or electricity cannot be had. I have never had any experience, but have an idea: Why would not the lamps such as are used in Pullman cars (of course I don't know anything about common "set-up" cars) be a good thing? I mean the kind that wind up and burn lard oil. The light is good, no danger of explosion, and no expense for breakage of lamp chimneys, which in a large shop is considerable. Perhaps the cost of the oil would be too great. If so, that settles it.

Boston, Mass. GREASER.

The Split Pulley Question.

Editor American Machinist:

It is not at all probable that Mr. Forbes and I will ever be led to agree on the split pulley question; and this discussion would be fruitless, were it not for the possibility that the less prejudiced may be led to decide, or to design some better method of joining and finishing split pulleys than that in common use.

So far as the discussion goes this will end what I have to say.

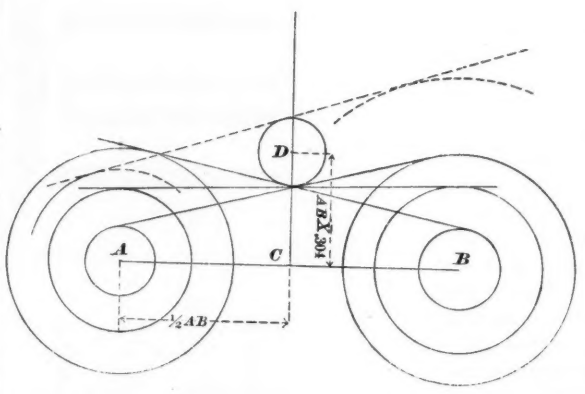
We do agree in this, however, that sharp edges coming in contact with the belt are bad. We also agree that many split pulleys as now made have sharp projecting edges. He thinks good workmanship would avoid that. I do not think so. That is, I do not think any amount of good workmanship within commercial limits, will insure a smooth surface on split pulleys constructed with a tight joint without a change in the present designs. By present designs is meant cast iron pulleys, cast, turned; and then split; or pulleys cast in halves, planed together, bolted, and then turned. I have seen but few that were not offset more or less when made, or that a blow would not drive in one corner and spring out the other so as to present a sharp projecting edge.

Mr. Forbes not only believes a tight joint and good workmanship will avoid projecting edges, but that a gap leaves sharp edges which can not be avoided I do not; and had I known as much two months ago as I think I do now, I should have not only drawn the pulley with one gap but with two, and drawn all the corners rounded. That is, instead of trying to balance two sharp corners so as to leave a smooth surface, I would have rounded all the corners off and then whatever happened to the pulley the surface would be smooth. The corners could be rounded in a tight joint as well as with a gap, but no workman, after trying his best to make a joint that would not show, could be induced to round off the corners; while the gap might so disgust him that a little persuasion would induce him to file the corners off. As to the gap being any serious objection it is quite imaginary, for I have seen a belt running months, and was told it had run years satisfactorily, driving from the teeth of a spur gear. I do not believe a gap of $\frac{1}{8}$ of an inch in the face of a pulley, even with the corners left sharp, at all comparable in its destructive power with a $\frac{1}{32}$ of an inch offset.

In the example given by Mr. Forbes, which was admittedly a slouch job, there was no evidence but what there was an offset as well as a gap, and he does not show how a bolted joint, under like conditions, would have acted differently.

We must either admit that the split pulley, as now designed, is, if well enough made, all that can be desired, or we must hope for something better. I believe the door-hinge plan will, with interlocking ears, hold the face of the pulley more evenly than the bolt plan. It will cost less, look neater, and, when so arranged that the pulley can be opened to go on the shaft, will be a convenience. Neither one of these things may be so, however; but I will take my chances on the value of the thought being equal to the adverse opinion. JOHN E. SWEET.

Syracuse, N. Y.



Cone Pulley Diameters.

Editor American Machinist:

Mr. Smith's tables on the cone pulley question in your issue of February 25, I find substantially correct.

The case that he assumes shows very conclusively that the method of using a point as a directrix is not general.

As he says, a directrix circle with a definitely located center is equally correct in all cases, for changing the size of the directrix circle changes all of the pulley diameters alike. The example I assumed, to test the accuracy of the point directrix method, was one that made the belt line come much nearer the center of the directrix circle than Mr. Smith's example. It will be seen that with very few exceptions, in practice, the center of the directrix circle will fall outside of the belt lines, and in the case of extreme angles, near to them, so that the error would be slight. But Mr. Smith has suggested a way of making the method general, by locating positively the center of the directrix circle. He proceeds by erecting a perpendicular to the line of centers and at a distance from the center of the small pulley equal to 0.496 times the distance between the centers, then laying off on this line from the center line a distance equal to the distance between centers divided by 3,1416.

Now if we can get a good approximation, by locating the center of the directrix circle on the perpendicular to the line of centers which bisects the distance between them, we can simplify the method somewhat.

I find the best location on this perpendicular to be 0.304 times the distance between the centers from the center line. Let us then locate the center of the directrix circle at this point.

In the Fig. *A* is the center of one pulley, and *B* that of the other.

Draw the line *A B* and bisect it by the perpendicular *C D:* make *C D* equal to 0.304 times *A B*, then *D* will be the center of the directrix circle. If we take the distance between the centers used by Mr. Smith (32 inches), we get the following table:

Number of changes.	Diam. of small cone.	Diam. of large cone.	Diff. of diam.	Belt angle.	Length of belt.
1	5.39	37.39	32	30°	139.39
2	8.03	36.03	28	26°	139.46
3	10.58	34.58	24	22°	139.49
4	13.03	33.03	20	18¼°	139.49
5	15.38	31.38	16	14¼°	139.45
6	17.65	29.65	12	10⅝°	139.44
7	19.85	27.85	8	7⅛°	139.45
8	21.96	25.96	4	3½°	139.40
9	24.	24.	0	0°	139.40

It will be seen by this table that the error is only .10, which is even better than Mr. Smith's approximation, which makes an error of 0.18—he says 0.22. But I think there is a mistake in the first change of his table; the diamters 5.40 and 37.40 are correct, but the belt length should read, 139.41 instead of 139.36. The error is too small to take into account in either method. I only suggested moving over on the bisecting perpendicular, to simplify the matter.

If a line be drawn through *D*, making an angle of 75° with *A B* toward the small pulley, and the center of the directrix circle be anywhere on this line the belt length will be correct for 30° and 0°. This line will cut the center of Mr. Smith's directrix, and his belt length is correct for 30° and 0°.

Now moving the center of the directrix circle on this line toward *A B*, decreases the belt lengths for the intermediate angles, but at the point *D* they are yet too great; therefore the position for the center of the directrix circle to give the closest approximations between 30° and 0° is toward the large pulley from *C D*, and not toward the small pulley as Mr. Smith represents. But the advantage of having it on the bisecting perpendicular, *C D* more than compensates for the slight difference. JOHN COFFIN.

Belt Tension.

Editor American Machinist:

I don't think I quite understand Mr. H. S. Wilson's diagram and explanation (p. 6, March 18th, 1882) of method of measuring or weighing power for cutting tools.

The driving power of a continuous belt is measured by the difference in tension of the slack and the taut folds; and both tensions must be known before the difference can be found.

Do I understand that your correspondent divided the weight in pounds, fastened to his inside idler, by the width of the belt in inches, to get the tension per inch of belt width? Such a method would be incorrect, because the belt is pulling at an angle on the weight.

Even supposing that, or any other, method gave the the correct tension, the method would it seems to me, be incorrect, because the arcs of contact of the belt on the two pulleys would vary with the weight, and not be the same in any two cases compared.

Even supposing the tension per inch to have been correctly measured, and the arcs of contact to have been kept constant, the tension would not indicate the proportionate power transmitted, because the driving power is not by any means directly in proportion to the tension, even when all other things which it is possible to keep equal, are the same.

If Mr. Wilson would use two idlers in a horizontal frame, the horizontal line connecting their arcs at right angles to that connecting the arcs of the pulleys on lathe and countershaft, and would see that the belt angles were 60°, he might, by a dynamometer or by a weight and pulley, measure the *difference* in tension between the up-running and the down-running sides of the belt, and this would give a very close approximation to the power transmitted, by multiplying by the lineal velocity of the belt per minute. Thus if there were 120 lbs. lifted by the difference in tension of the two folds of a belt, running 400 feet per minute, the power trans-

mitted would be $\frac{120 \times 400}{80000} = 1.45$ horse power, neglecting friction of the dynamometer.

ROBERT GRIMSHAW.

Philadelphia, Pa.

Cylinder Condensation.

Editor American Machinist:

While Votre Ami is getting the amount of surface and the time of exposure to condensation in his steam cylinder down so very fine, hadn't he better look further for modifying causes. If the cut-off is at ¼ stroke, there is, during the first stroke-quarter, a cool surface equal to both heads and ⅛ the sides, exposed to live steam at a certain high pressure and temperature not greatly varying. After cut-off, there is exposed to *expanding* steam of medium and decreasing pressure and temperature a surface equal to both heads, and to ⅜ the sides (supposing no exhaust lead). After release, there is exposed to volume of steam at low and practically constant pressure and temperature a hot area equal to both heads, and to ½ the sides (supposing no compression nor steam lead).

The above conditions neglect cylinder clearance and re-evaporation. How will they cipher up? ONE DIAMETER.

About Belts.

Editor American Machinist:

In your issue of February 4, I noticed an article from Robert Grimshaw on belts. As I am interested in such matters, I wish to give my conclusions on the question of the driving power of belts. These are, that the actual driving power of a belt on any kind of a *smooth* pulley is measured by the atmospheric pressure on the surface of the belt in contact with the smallest pulley; that is, always provided that the belt is clean.

If belts are allowed to become covered with grease, dirt, rosin, &c., or if they are allowed to become dry and hard, it must not be expected that the belt will work air-tight on the pulleys. In many instances no more than 25 per cent. of the power that ought to be realized, is realized. By making the belts too tight much loss results. The simplest example that occurs to me is that of a four-wheeled wagon. When empty, a small boy will draw it, but when loaded it may take several men to move it. It is the same wagon, the friction on the journals being simply increased by the addition of the load.

Another example is that of a foot-lathe. Make the belt only a little too short and you will not be able to run it.

Many believe that by placing a tightener against a belt they will obtain a great deal more driving power. This gain in power is only the equivalent of the extra surface with which the belt is brought in contact by the use of the tightener; and in the case of a horizontal belt, this will be nearly or quite all lost by friction. In the instance of an upright belt the tightener may be useful.

A great economy is realized by working with slack belts, keeping them clean and flexible or elastic. If they become hard and stiff, wash them with luke-warm soda water, scrape them clean, oil them, and the trouble disappears. The expense of constantly breaking belts, as well as the annoyance, is serious. I have found kerosene oil to be the best for softening leather belts, but I am not as yet certain that it will not injure the leather.

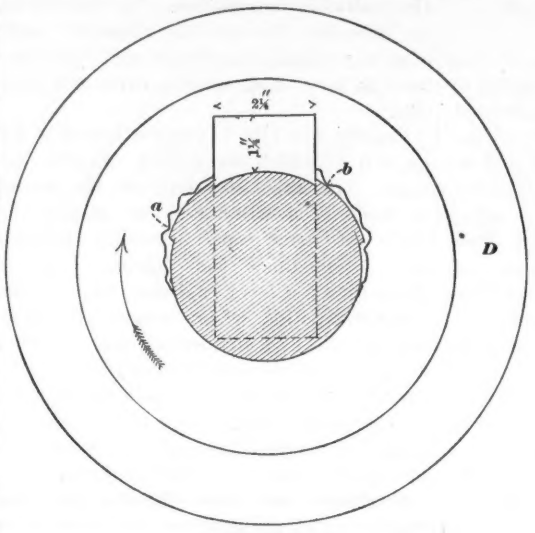
A. CHRISTOFFEL.

A Wide Key.

Editor American Machinist:

There seems to be quite a diversity of opinion as to the proper width of keys. For ordinary work, the rule of one-fourth the diameter of the shaft works well, but for heavy work, and obstinate cases, I do not limit myself even to one-third the diameter of the shaft, but give width in what the doctors call "heroic doses."

I have to thank J. C. (Feb. 18), for his idea on the limit of elasticity in iron. I had never thought of that in connection with a key. I have noticed it in the tensile direction of iron, as in tightening nuts on bolts in reamed holes. In bolting on locomotive cylinders, I have stretched the bolts so that they did not fill the holes, and had to have others made.



A WIDE KEY

The widest proportioned key that I now call to mind is in a main driving pulley, which transmits the power from an engine of 100 horse power. The shaft is of steel, 4" in diameter. The key is also of steel, and is 2¼" in width. The hub of the pulley is 14" in length. Other shafts had been broken in the keyway, and other keys had been "chawed up" by this pulley.

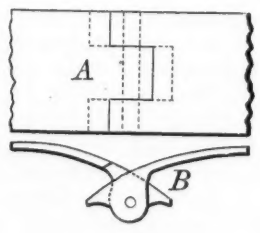
This new shaft, when in the rough, had metal enough to allow of forming two solid feathers, quartering as shown in sketch. Feather *a* is ¾" wide, nearly $\frac{3}{16}$" high; *b* is ⅝" wide by ⅛" high. The length of each is about 18". The rounded contour is retained between the feathers. No keyway is cut in the shaft, but a key is fitted to fill up between the feathers, as shown in sketch.

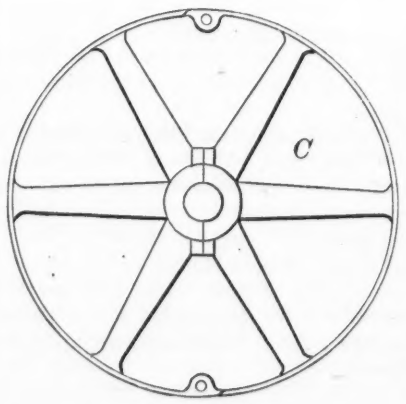
Wrought bands *D*, of 1½" square iron are shrunk on the hub of the pulley. The keyway is cut in the most damaged part of the hub, and, as shown by the waving lines, the hub and the feathers do not come in contact at all. The pulley moves in the direction indicated by the arrow, and that ⅛th of an inch is all the shoulder it has, and it has stood the test of one year's work, showing no signs of failure. What holds it?

Imagine a square, three sides of which are represented by the dotted lines, and let the bearing of the key form the fourth side of the square, and I think the advantage of a wide key will be apparent. In former letters to THE MACHINIST I have referred to this as the wrench principle.

OLD JOUR.

Defiance, O.





A Hinged Pulley.

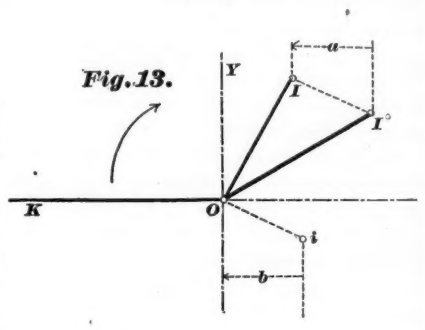
Editor American Machinist:

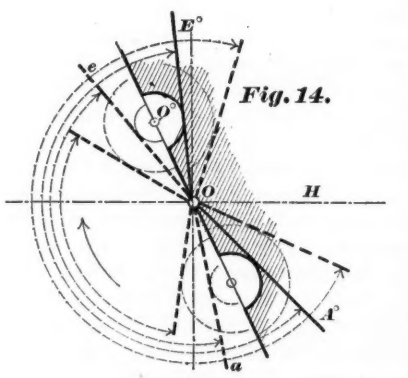
The enclosed sketch representing part of a the rim of a pulley 12" diam. ×3" face, is an attempt to solve the hinged split pulley problem, over which there has been so much controversy lately in the columns of the AMERICAN MACHINIST. Gotten up in a great hurry, no attempt was made at proper form or proportions, the object being to prove the easy practicability of hinging the rim of a split pulley so that it will open to slip over any size of shaft, and at the same time be substantial and less unsightly than the common split pulley. It has no "gap across the face," nor any other mark that would, after fair workmanship, operate in the least against its usefulness.

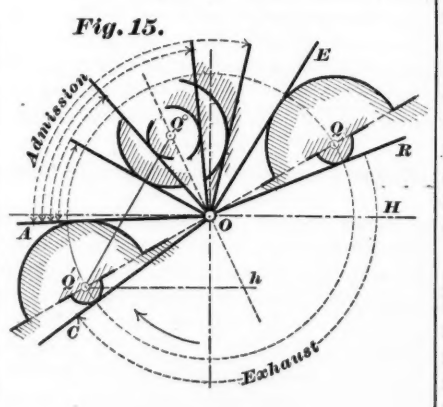
Referring to the engraving, *C* it represents the pulley entire, while *A* and *B* represent respectively a face and side view of a portion of the rim, showing the hinge as it would appear with the pulley opened to be placed over the shaft.

ARTISAN.

Brooklyn, N. Y.







The Meyer Cut-Off.

BY HUGO BILGRAM.

Of all positive motion valve gears, the one known as Meyer's Cut-off, with its various modifications, is undoubtedly the one most extensively in use.

The cut-off valve moving on the back of the main valve consists of two plates, the distance between which can be changed by various means. Two separate eccentrics are employed, one for the main valve, the other for the cut-off valve. The main valve is provided with an exhaust cavity, the same as the common slide valve, and with two admission passages.

In order to analyze the operation of the cut-off valve, it is necessary to consider the motion of the cut-off valve in relation to that of the main valve, since the main valve is the seat of the cut-off valve. If *I* (Fig. 13) represents the location of the main eccentric, and I^c that of the cut-off eccentric, *O K* being the position of the crank, the distance marked *a* will represent the distance of the cut-off eccentric from its neutral position on the main valve. If now the line *O i* is drawn equal and parallel to the line $I\,I^c$ connecting the centers of both eccentrics, the distance *b* of the point *i* from the vertical center line *O Y* must of necessity be equal to the distance *a*, and as this same relation will continue to exist after the crank-shaft is rotated through any angle, the point *i* may be considered the ideal eccentric for the relative movement of the cut-off valve. That is, a valve moved by the eccentric *i* will move in relation to a fixed seat exactly (angularities of eccentric rods not considered) as the cut-off valve is moving in relation to the main valve. The cut-off valve diagram (see page 4, No. 5, current volume) can therefore be drawn as shown in fig. 14, by making the angle *H O Q*° equal to the angle *Y O i* of Fig. 13, and the distance *O Q*° equal to *O i*, when the completion of the diagram is only a question of finding the proper lap of the cut-off valve. This may be done by assuming both eccentrics placed at right angles with the eccentric rods, or (which is practically the same) by supposing both eccentric straps to be placed in a position concentric with the main shaft. If the lap of the cut-off valve is found to be negative, the lap circles can be drawn in the diagram with a radius equal to this negative lap, and the concave sides of the circles being in consideration, the diagram for the cut-off valve assumes the form shown in Fig. 14. The cut-off valve will admit steam to the passage of the main valve between the crank angles *O A*° and *E*° *O*.

If now by the spreading of the cut-off plates the cut-off lap becomes positive, the time of admission of steam to the main valve is contracted, taking place from *O a* to *O e*. A still greater spreading may reduce the time still farther. On the other hand, a closing of the cut-off plates increases the length of time during which steam is admitted, the negative lap being increased. In the diagram Fig. 14, four different grades are indicated, two for positive and two for negative laps of the cut-off valve.

The action of the main valve may be considered conjointedly with that of the cut-off valve, as shown in Fig. 15. This drawing shows quite plainly that the point of cutting off can be varied to any point between the crank positions *O A* and *O E*, *i. e.*, throughout the range of admission of steam by the main valve, provided the cut-off plates have a sufficient range of adjustment. There is, however, a chance that the inside edge of the cut-off plate may open the passage of the main valve when not required, and the plates must be made wide enough to prevent such an occurrence. This again necessitates spreading of the main valve passages, and of the valve chest.

In tracing back the mode by which the point *Q*° of the diagram was found, it will be discovered that the line *Q' Q*°, Fig. 15, represents the cut-off eccentric in the same manner in which the line *O Q* represents the main eccentric. *O Q* is the eccentricity of the main eccentric, and *Q' Q*° that of the cut-off eccentric; *H O Q* represents the angular advance of the main eccentric, and *h Q' Q*° that of the cut-off eccentric, *Q' h* being a horizontal line.

If these points are properly taken into account, there can be no difficulty in designing a valve gear of the above description to vary between given limits of cut-off, or otherwise comply with given conditions.

Instead of two independent plates of adjustable distance, other means for varying the lap are frequently embodied in the construction of such valve gears. In one well-known instance the edges of the solid cut-off plate are made inclined, and the lap varied by a lateral movement of the cut-off valve. In order to reduce the space required for such lateral motion, the cut-off valve face is made cylindrical.

The diagram, Fig. 15, shows strikingly the advantage of the slide valve diagram suggested by the writer.

One of the happiest outcomes of the Atlanta Fair, says the *Scientific American*, is the demand that has sprung up, not for more money, but for more men in the South, practical men, as they are pleased to style them down there, by which they mean mechanics, not those whose trades are their masters, but who are masters of their trades.

This demand is not coming from those who are dazed with the cotton manufacturing craze alone, but from farmers, blacksmiths, tailors, machine shops, and other industries,

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NEW YORK, APRIL 1, 1882.

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Copying Machine Tools Abroad.

It is a fact quite generally known that American machine tools have been copied by European tool makers for several years past. It has never given our manufacturers of machine tools any special uneasiness, and we can not say it ever will prove any serious disadvantage, except to those who are selling their productions to some considerable extent abroad. Within a few months German machinists have copied some American machines so closely and with such workmanship as to rival the originals in the foreign markets. The external finish is not as good as that of the machines copied, but the fitting, we are informed by engineers who have inquired into the matter, is first class. With cheap labor the Germans are enabled to send these copies to the London market and undersell the originals from 25 to 40 per cent. With a demand for machine tools at home greater than the supply, this stealing of patterns does but little damage, but when a dull season appears it will probably be a matter of some concern to our leading machine tool builders.

We have seen it stated that the German Government intends hereafter to be represented in this country by an architect and engineer, in addition to the ordinary consular force, in order to obtain early and accurate information regarding improvements. Doubtless such action would be wise upon the part of the German nation; but it admits of little question that some of the German manufacturers would do well to substitute original research for some of the copying which they now do, in the case of American machinery. Copyists seldom do good work, or earn the confidence of those with whom they deal, for the reason that they do not study the principles involved, think out nothing original, and are about as likely to copy the bad points of American machines as their good ones. In the present rush of business in this country, probably little perceptible damage results from the habit, which some German manufacturers have formed, of ordering single machines from America for the purpose of making duplicates and passing them off as their own manufacture, but the time may come when this matter will demand more attention from American manufacturers than it has heretofore received.

Undue Concentration of Pumping Power.

A matter which should greatly interest the people of every city or town large enough to have water works facilities, is the prevalent tendency to the concentration of pumping power in one or two large engines, instead of distributing it among a number of small engines of equal aggregate capacity. Instances are not few in which this tendency has resulted for weeks together in a partial or total stoppage of pumping facilities, leaving the town either without water, or without sufficient water for reasonable fire protection. A case in point may be cited, as occurring in a Western city having two large pumping engines. A breakdown took place in one of the engines that could not be repaired without considerable delay. As a natural consequence, the other engine was driven beyond its ability to stand, and the sequence of the whole was that for weeks the city would have been powerless to resist anything resembling a severe conflagration, had not expensive temporary apparatus been put in while the total bill for repairs and auxiliary appliances fell but little short of the original cost of the large engine.

Had the city depended on several small engines, instead, it is hardly conceivable that more than one could get out of order at a time, while it is highly probable that no breakage would have occurred in any, which could not be repaired in two or three days' time, or at an expense not exceeding a few hundred dollars.

Another point illustrating the financial unwisdom of the prevailing practice is the fact, that four or five small engines aggregating, say, a daily capacity of ten million gallons, can be constructed, foundations included, for probably one half the amount that a single ten-million-gallon engine will cost, also including foundations. The interest on the difference between the respective sums of money usually involved in such constructions is no trifling matter, even to a large city.

Usually it is idle to suggest remedies for an evil of which we cannot discover the cause. In this case one of the causes at work is a willingness to gratify the pride of some one or more individuals. Sometimes the moving cause is the pride of a local engineer, who, in the vast construction, wishes to erect a life monument to his own engineering skill. In other cases, one or two prominent city officials desire to perpetuate themselves in the memory of their townsmen in a way that would less strikingly appear, if several smaller and simpler constructions were decided upon.

Engineers and city officials, who are tempted to let personal considerations sway their judgment in matters of this kind, would do well to reflect, that less glory in the present, and more satisfaction in the future, may perhaps, wisely be preferred to the results of the costly, uncertain and unsafe method now so largely in vogue.

The Ethics of Deceptions.

A great many individuals who are not troubled with a conscience are trying, by various ingenious efforts, to make money by humbugging people into buying some commodity, while believing they are getting another and quite a different article. In most cases infractions of the law are carefully avoided, and the business is therefore allowed to go on as long as there can be found enough customers, whose wits are not sufficiently sharpened to detect the cheat.

Some State legislatures are now discussing proposed measures to put a stop to a few of the most notorious commercial humbugs of the day. As soon as a measure of this kind is introduced an outcry is sure to be raised against interfering with the rights of trade, as if systematic deception were a vested right which legislatures were bound to protect. While there is nothing on its face derogatory to commercial honesty in making and selling glucose, oleomargarine, clarified syrup, and newly set-up machinery and boilers composed in part of old and worn machines and boilers, there is neither honesty nor should there be cover of law for selling glucose for common "store sugar," oleomargarine for butter, sugar syrup for honey, or reconstructed machinery and boilers for new. Deliberately planned deception should be treated with something more than public contempt, which is no punishment for the kind of individuals who are capable of regularly practicing commercial humbuggery. A bill to prohibit the coloring of oleomargarine, to give it the appearance of butter, recently came near becoming a New York State law, but opposing interests were strong enough to defeat it. It does not appear that the addition of coloring matter improves the article in quality; it does, however, give it the appearance of being something it is not. The wisdom of protecting the deceptive part of the business will hardly be appreciated by fair-minded men.

Parties in some localities are palming off machinery upon purchasers as *new*, which is made, in part, from pieces taken out of old machines. If there is no law to prevent such deception there ought to be such a force of public indignation brought to bear upon the perpetrators of these tricks, that would effectually drive them either out of business or into strictly honest commercial transactions.

Manufacturing Integrity.

In the machine business, as in all other enterprises, perhaps more than in most others, the successful establishments are those that maintain their standard of excellence under all circumstances. Such establishments sell their productions, not so much because they are known to be good as because their established reputation is taken as a guarantee for what they may agree to furnish. Even a failure, sometimes, to come up to their usual standard does not work permanent injury; that is, it is overlooked or charged where it probably belongs—to inadvertence on the part of some one. A reputation for integrity of this kind gained by years of effort, thus becomes, just as it should do, an important factor in the value of a manufacturing business. It forms a basis on which contracts are made, and becomes to all intents a part of the capital, quite as much as the money invested. It is capital that may not be assessed, upon which no taxes are paid, but which can nevertheless be definitely located if not appraised. This is capital that a concern just starting in business does not possess. Individually, the members may be known as honest men, but it is not altogether a question of individual honesty. In fact, it may not—although it usually does—include the quality of honesty at all, or to any great extent. Whether it does or does not, it is more particularly a question of policy.

Little failures in the standard of excellence are by no means overlooked in the instance of new parties in the business, to the same extent that they are in the instance of those who have established a reputation for delivering exactly what they sell. In the case of the former, buyers are looking for defects, and to a certain extent are disappointed if they do not find them. When found they are at once taken as the *rule*, and it becomes an exceedingly difficult matter to overcome prejudices, and set aside opinions hastily, perhaps unjustly, formed. To say this is not right does not help the matter any, since it does not set aside the fact that it is so, and will continue to be so. In the case of the latter the disappointment is in finding things that are not right, and which are, as a matter of course, considered the *exception*. The well-earned reputation is taken, and quite properly, to show what was intended.

Every new manufacturing enterprise must run this gauntlet of criticism that usually condemns without a hearing, before they can add a reputation so essential to success, and it is the rock on which many split, not always through any intentional fault. On the contrary the intention may be of the best. It is not as a rule the large things that manage to bring manufacturing enterprises to grief in this way, but rather the small and so-called unimportant ones. Those things that are apparently easily remedied—apparently, for after all it is these little things—these trifles—that present the most difficulties, and that, being overlooked because of their assumed insignificance, do the most damage. The screw that is improperly fitted *here*, and that is unnoticed or let pass because it is not of much magnitude, or is assumed to be of but little consequence, or the fit *there* that wants only a trifle of being just right, and will be better when it wears a little, often does more to condemn the character of machinery than faulty design, or some other feature that is worth grumbling about. The trouble is that it is not worth finding fault with, but at the same time it produces unfavorable impressions that are not counteracted by all the other parts that are just as they should be.

It not unfrequently happens that machinery is allowed to go out, and stand, as it will stand, a representative of the character of the builders, that had infinitely better have been broken up at the total loss of its entire value than suffered to havebeen sold at any price—particularly in the instance of a new manufacturing enterprise that is hoping to build up a reputation and a business on the character of its products—and this, too, in spite of the very best intentions.

It may well happen that a manufacturer is unwittingly making history that is by no means such as he desires, in times like these when the question is not always so entirely one of merit as it usually is. The intent, of course, is not to establish a business to stand the conditions of an extraordinary demand, but rather one that shall stand the adverse conditions of dull times. Nothing can do this but strict fidelity, and this fidelity must particularly extend to what are called the small things. It is never wise to suppose that the things which pass uncommented up-

on are unnoticed, or that in the future they will be without weight.

As previously intimated, manufacturing integrity may not have any connection with common honesty, but the former is quite as essential in building up manufacturing success as the latter is in retaining it.

Mr. George B. Foote, of Helena, Montana, who is contributing a series of interesting and instructive letters on mechanical subjects to our columns, writes us that the one on Turning True Tapers was the means of his learning the address of an old "chum," who was with him in Watertown, N. Y., over twenty years ago, but who now holds a responsible position in a Holyoke (Mass.) shop. Several instances of this kind have come under our observation, where our "Letters from Practical Men" have been the means of bringing into communication friends long separated, and who had no knowledge of each other's whereabouts.

In this issue we present the third of a series of articles on "Comparison Between High and Low-Speed Engines," by Charles A. Hague. The advantages of high-speed engines have been very clearly pointed out in our columns by Mr. Charles T. Porter and others, and it is proper that the advocates of low speed (or lower speed), of whom Mr. Hague is an able representative, should also have their arguments presented as freely. This series of articles will continue in probably three or four more issues, and will be read with particular interest by engineers.

The article this week, by Hugo Bilgram, analyzing the Meyer Cut-Off, will prove of value to a large number of engineers.

QUESTIONS & ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

(104) F. F. T., Carthage. N. Y., asks: Will you inform me how fast to run an emery wheel 3" in diameter for light grinding? *A.* About 3,000 revolutions a minute.

(105) J. G., Clinton, Iowa, asks: How shall I calculate compound gearing for screw cutting in the engine lathe? *A.* See "Screw Cutting in the Engine Lathe," by Frank H. Richards, in the AMERICAN MACHINIST, Oct. 15, 1881.

(106) F. J. B., Philadelphia, Pa., writes: Will you please tell me in your next issue, what will be the effect of a kind of boiler setting, which carries the flame over the top of shell? I think it will overheat and therefore weaken that part of the shell where there is nothing but steam. Another says not. The boiler is to be fired with planing mill refuse. *A.* Many boilers are set in the way you describe for burning the kind of fuel mentioned, and so far as we know without evil results.

(107) W. I. C., Chicago, Ill., asks: 1. Can a casting be made of iron 17" long and 1¼" in diameter, with a ½" core nearly but not quite the entire length? *A.* We do not think you will be able to successfully make a casting with a ½" core 17" long and supported only at one end. You could probably make such pieces by allowing the core to extend entirely through, and afterwards plugging one end. 2. I want to use these castings for steaming the fire in a furnace, and wrought iron burns out. Which would last the longest, wrought, cast or malleable iron? *A.* We think there would be but little difference.

(108) P. M. S., West Chester, Pa., asks: 1. What quantity of air is required to melt iron in a cupola? *A.* About 250 cubic feet for each pound of coal used. 2. Is not too much air usually supplied to a cupola? *A.* We think not, as a rule. 3. Will a cupola melt better in some kinds of weather than in others? *A.* There is a little difference, but if the supply of air is sufficient it is hardly noticeable. 4. Would a jet of steam assist in melting? *A.* We think not materially.

(109) R. H., Enterprise, Miss., asks: How can I babbitt boxes on the shaft on which they are run, so that I can remove them after babbitting? *A.* It is somewhat difficult to do this with ordinary babbitt. It will help matters some to smoke the journal with a smoky lamp so as to deposit lamp black on the surface, or cover the surface of the journal with a thin wash of pipe clay. Another plan we have sometimes adopted, is to fasten a piece of writing paper around the journal, and pour the babbitt on this.

(110) E. S. B., Auburn, N. Y., writes: I am trying to study mechanical drawing but find some trouble in inking my drawings, but whether in the ink or in the pen I am unable to tell. When the pen is first dipped in the ink it will mark very heavy for an inch or so, then very light, and then not at all. 1. Can you tell me what is the trouble? *A.* We should suppose by your letter that you dipped your pen in the ink, which would account for its not working properly. Put the ink between the blades with a small piece of wood whittled quite thin and flat. The trouble may be in your ink; this may be of poor quality, or you may not rub it down properly. It should be rubbed very slowly and carefully, otherwise you will have trouble of the kind you describe. 2. Can you tell me of anything to put in India ink that will keep it from evaporating? *A.* No. Grind the cover on the dish so that it will be air tight, and keep the ink covered.

(111) G. C. M., Athens, Ga., asks: What is the proper speed for milling machine cutters; also at what speed should the work be fed? *A.* We have referred your questions to the Brown & Sharpe Manufacturing Co., who have courteously furnished us with the following reply: "The proper feed and speed for milling cuts is so much varied by the many different conditions of the work to be done, such as length and width of cut, shape of cutters, amount of stock to be removed or depth of cut, etc., etc., as also the stiffness of the machine upon which the work is done; that it is a difficult matter to give any fixed rule for the same. Good practice would seem to be: say, for wrought iron or soft steel, a surface velocity of cutter of 30 ft. per minute, and a feed of from one to two hundredths of an inch to each revolution of cutter, for cast iron, surface velocity, 40 to 50 ft. per minute, feed, two to three hundredths of an inch to one revolution of cutter; for bronze, say 60 to 75 ft. surface velocity; feed, three to four hundredths to one revolution of cutter. But, as before remarked, these speeds and feeds may be very much changed, either increased or decreased. We have one short cut running in our works on annealed cast iron, where the mill runs 200 revolutions per minute, with a feed equal to 9¾ inches in the same time, which is equivalent to a surface velocity of 116 ft. per minute, and a feed of about five one-hundredths of an inch to one revolution. the mill is 2¼" diameter."

(112) J. H. F., Pittsburgh, Penn., writes: I have a work on belting that contains the following rules: "Multiply 33,000 by the number of horse-power, divide the amount by the number of feet the belt is to run per minute, divide this quotient by the number of feet or parts of a foot in length of belt contact with smaller pulley, divide this last quotient by six and the result is the required width of belt in inches." Then again the following: "Divide the number of square inches of belt in contact with the pulley by two, multiply this quotient by the velocity of the belt in feet per minute, and this amount divide by 33,000 and the quotient is the number of horse power." Can these rules be relied upon, and if so why are the divisors 6 and 2 used? *A.* In reference to the reliability of these or other rules, we can only say that there are, so far as we know, no rules given that cover all the ground, and till further knowledge in reference to the matter is obtained it is impossible to give any rule that will apply in all cases. The rules you quote, while they may be quite right for small pulleys would seem to provide for considerable more belt than necessary on medium sized ones. This, however, is a departure in the right direction. The reason why the divisors 6 and 2 are used is probably that these rules are based on the assumption that a certain number of feet, or inches, in contact with a pulley per minute is equivalent to a certain number of foot pounds, and these numbers are used as handy constant factors. It is not absolutely necessary to use them at all, as for instance the first rule could be expressed as follows: Divide 55,00 by the speed of belt per minute, and by the length of belt contact in feet.

BUSINESS SPECIALS.

Transient advertisements 50 cts. a line for each insertion under this head. About seven words make a line. Should be received Wednesday morning.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N.J.

James W. See, Consulting Engineer, Hamilton, O.

Presses and Dies. Ayar Mach. Works, Salem, N. J.

Alfred Wilkinson, Expert Tests of Steam Engines and Boilers, 123 N. 4th St., Phila.

Latest and best books on Steam Engineering. Send stamp for Catalogue. F. Keppy, Bridgeport, Ct.

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill.

J. C. Hoadley, Engineer and Expert, 29 High St., cor. Federal, Boston, Mass.

"To stop leaks in Boiler Tubes use Quinn's Patent Ferules. Address, S. M. Co., South Newmarket, N. H."

For Sale—A valuable patent on a Door Butt, by which a door can be adjusted any way you wish. For particulars address, C. H. B,, Post Office box 498 Holyoke, Mass.

"How to Keep Boilers Clean," and other useful information for steam users and engineers. Book sent free by the publisher, Jas. F. Hotchkiss, 84 John Street, N. Y.

"Slide Valve Gears," by Hugo Bilgram, published by E. Claxton & Co., Phila., describes the easiest method known for correctly proportioning slide valves, link-motions and cut-off gears; price, $1.00.

Russell & Struthers, Wax Process for making outline engravings. Specimens each week in the AMERICAN MACHINIST. We also do Map Engraving with best facilities. Russell & Struthers, 59 Park Place, New York.

Steel Name Stamps, 15 cts. per letter; Steel Figures, $1 per set. W. G. Sackmann, 59 Vine street, Cleveland, Ohio.

J. W. Penfield, Willoughby, Ohio, writes to T. New, 32 John street, N. Y.: We are well pleased with the Prepared Roofing; will want more of it before long.

"Sibley College of Mechanic Arts, Cornell University.—Entrance examinations will be held June 12th and September 11th, 1882. For the register and catalogue just issued, containing reorganized courses of instruction, scientific and practical, including draughting, machine construction, general shop work, etc., apply to the President of Cornell University, Ithaca, N. Y."

The Student's Illustrated Guide to Practical Draughting. Price, $1.00. Lectures in a Workshop, with an appendix containing famous papers by Sir Joseph Whitworth on "Plane Metallic Surfaces," "Uniform System of Screw Threads," etc. Price, $1.00. Either work sent on receipt of price on application to the author, T. P. Pemberton, 142 Greenwich Street (P. O. box 3083), New York.

"Patent Binder" for the AMERICAN MACHINIST holds 52 weekly issues in good shape. Sent to any address by mail for one dollar. We can furnish Volume 3 of the AMERICAN MACHINIST, containing the full 52 issues of 1880, neatly bound in cloth, ready to ship by express, for four dollars. Unbound, three dollars. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton Street, New York.

Ealy's "Blue Book,"—Special classified list of Machinists, Machinery, Railway, Engine and Boiler Makers supplies, etc., with financial standing and paying qualities of all dealers and manufacturers. Much more convenient and reliable than any other work of the kind published. We also furnish full detailed written reports. Price $30 to July 1, 1882. The JOHN W. EALY COMPANY, 51 Chambers street, New York or 79 Dearborn street, Chicago, Ill.

"Extracts from Chordal's Letters," the most interesting mechanical book published. A great variety of mechanical and business topics treated in a wise and witty way that will be instructive to old and young mechanics, and interesting to everybody. As many as 150 copies have been sold in a single shop. Over 40 Humorous illustrations; 320 pages, 12 mo. Price, $1.50 per copy, by mail, to any address. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton St., New York.

MANUFACTURES.

The Omaha (Neb.) Nail Works have doubled their capacity, and increased their capital stock.

A manufactory for making agricultural implements is to be built at Keene, N. H.

The Phosphor Bronze Smelting Co. of Philadelphia is manufacturing wire rope from phosphor-bronze.

Gibson & Bland, bridge builders, will put up new works at Coatesville, Pa. The works will start with 125 men.

The Niles Tool Works, Hamilton, Ohio, have enlarged by the addition of a new building 150x40 feet. They are running 23 hours a day.

The Holly Manufacturing Company, Lockport, N. Y., are building a new foundry 100x80, the present one to be used for an erecting room.

The Youngstown, O., Car Works are full of orders for heavy freight cars. During the coming season they expect to largely increase their capacity.

Flynn & Emerich, Baltimore, Md., are building one of their automatic cut-off engines for the Powhatan Cotton factory.

McMahon & Carver, Machinists, of Worcester, Mass., are to build a new shop 100x40 feet to accommodate the increase in their business.

The Columbus (Ohio) Machine company are building a new blast engine for the Thomas Furnace Company, of Niles, Ohio.

The Callwell & Collins Norway Bolt Company, Cleveland, Ohio, are making foreign shipments of their products.

Alliance, Ohio, is to have a stove manufacturing company, more than two-thirds of the stock having been subscribed.

The citizens of New Comerstown, Ohio, have subscribed sufficiently to induce Adams & Bailey of Dresden, to locate a large iron foundry at the former place.

The Chicago Screw Company, Chicago, Ills., are increasing their facilities by the addition of new machinery from time to time. They are at present employing 60 men.

The contracts for the enlargement of the Indiana Cotton Mill at Cannelton, Ind., the first and largest in the state, have been let. The enlargement and additional machinery will cost $250,000.

The steel works of the North Chicago Rolling Mill Company will begin operations at South Chicago, April 1, next, and will give employment to over 1,000 men.

The cogging and rolling mill engines for the Bessemer steel works in process of erection at Scranton, Pa., are being made by Davy Brothers, of Sheffield, England.

The Elyria Screw and Pipe Co., Elyria, O., has been consolidated with the Hartford Machine Screw Co. The Elyria branch will continue work upon an enlarged scale.

The new cotton factory now building at Lowell, N. C., will have 12,000 spindles, which capacity will soon be doubled. The building will be 600 feet long when completed, and 1,000 hands will be employed.

The cabinet lock business of P. & F. Corbin, New Britain, Conn., will pass into the hands of a recently organized company with a capital of $2,000,000. The company will immediately erect a large factory.

James Jenks, Detroit, Mich., writes us: The sales of my Duplex Injector are constantly on the increase, and I am daily receiving testimonials as to its efficiency and reliability as a boiler feeder.

Henry Woods' Son & Co., Charlestown, Mass., are putting in a Babcock & Wilcox boiler, to be set with the Jarvis Patent Furnace. They have purchased a Lawrence Engine to run 300 revolutions per minute.

W. F. & F. C. Sayles, Pawtucket, R. I., are the largest bleachers in the United States. They are now building an immense dye house and have put in two batteries of the Babcock & Wilcox water-tube boilers. These have been set with the Jarvis Patent Furnace.

Wm. H. Warren, Worcester, Mass., manufacturer of special machinery, has moved into a new shop with double the amount of room and tools. He reports business brisk on his specialties, 12" stroke shapers and five foot radial drills.

The Portland Machine Company, Portland, Me., have ready for delivery to the Aroostock River railroad, two 36-ton, 8-wheeled locomotives. This company is to furnish the Northern Pacific road with 34 locomotives of the same size as those mentioned.

Nordyke & Marmon Co., Indianapolis, Ind., are making the machinery for an elevator with a capacity of 12,000 bushels, to be erected at Rochester, Ind. This company are manufacturing the machinery for a large flouring mill to be erected at Durango, Mexico.

The Standard Electrical Works and the Standard Brass Works have been incorporated in Kentucky, to be located between Covington and Ludlow. The corporators are Messrs. Post & Co., railway supply merchants, of Cincinnati. They expect to employ in the two enterprises at least 400 men.

There is said to be a movement on foot, says the *Industrial World*, for the removal to Chicago of the extensive locomotive works at Providence, R. I. If located there, they would furnish employment to 1,500 men, and would be provided with facilities for turning out one first-class locomotive every 24 hours.

A Stock company is being formed by the citizens of Port Deposit for the purpose of buying the large iron foundry from the Messrs. Bibb & Son, of Baltimore. The price to be paid is $20,000, which includes buildings, patterns, tools, &c. Shares are placed at $25 and are selling rapidly.—*Baltimore Journal of Commerce.*

Messrs. Shatto & Dennis, of Minneapolis, Minn., have accepted the general agency for the Northwest for the Atlas, Corliss and Slide Valve Engine, built by the Atlas Engine Works, Indianapolis, Ind., They are doing a "booming" business and keep a full supply of engines on hand for immediate delivery.

Henry Hammond, formerly of the Hammond Hammer Company, of Hartford, Conn., is designing and buying tools to be used in the manufacture of axes, at Pittsburg, Pa. New processes are to be used in the manufacture by which it is said superior results will be produced. Mr. Hammond has the reputation of being one of the most expert workers in steel and iron in the country.

The Denison Paper Manufacturing Company, of Canton, Me., is erecting two additional soda-ash reclaimers of the Russell-Jarvis pattern, making seven in all. This style of reclaimer is said to be, without doubt, the most efficient of anything in its line, as well as the cheapest. It has a capacity of reclaiming from 2,700 to 3,000 pounds of black ash every twenty-four hours.

The Boston Rubber Co., burned out some weeks ago, have decided to locate in Holyoke, Mass., after considering Birmingham, Conn. The Shelton Water Power Co., made them an advantageous offer to locate at the latter place but Holyoke outbid them. They will employ about 3,000 hands making a probable addition of about 5,000 people to Holyoke.

The Atlas Engine Works, Indianapolis, Ind., are crowded with orders and have been shipping engines recently at the rate of one hundred per month. Shipment has just been made of two large engines, one going to Portland, Me., for a locomotive works, and the other to Ouray Co., Colorado, for the Brooklyn & San Miguel Mining and reduction Co.

The Jarvis Furnace Co., of Boston, have decided to start an agency in Atlanta, Ga., and will open an office in the block with Davenport, Johnson & Co. Mr. Frank Lederle will have charge of the same. At the present time this company are doing a large business in the South and have work going on at Nashville, Tenn., Louisville, Ky., Anniston, Ala., Columbus, Ga., Augusta, Ga., New Orleans, La., Charleston, S. C., Graniteville, S. C., and Petersburg, Va. In building new cotton mills, the owners are availing themselves of all the new improvements.

The greatest activity prevails at the immense works of the Cambria Iron Co., Johnstown, Pa. Some idea of the extent of the works may be obtained from the figures given below. Mineral Lands owned by the Company, 43,000 acres; Number of men employed, 8,300; Annual capacity in tons, 2,240 lbs; Pig Metal, 250,000 tons; Steel Ingots, 175,000 tons; Steel Rails, 125,000 tons; Puddle Bars, 35,000 tons; Iron Rails, 50,000 tons; Rail Fastenings, 5,000 tons; Iron and Steel in other shapes, 50,000 tons; Coke, 300,000 tons. Under the able management of the General Superintendent, Philip E. Chapin, additions are being made to the capacity of the works, and many improvements are in progress.

Machinists' and Engineers' Supplies.

NEW YORK, March 16, 1882.

The dealers report business a little more brisk during the past week than when last reported. Brass and Iron fittings are still scarce, some sizes being obtained with difficulty. Wrought Iron Pipe can be bought at a discount of 60 per ct. from list.

Iron and Metal Review.

The Pig Iron market remains quiet and the transactions are confined to those of a hand-to-mouth character. Prices are unchanged materially. We quote:

Foundry No. 1 at $26 to $26.50; Foundry No. 2, X, $24.50 to $25; Grey Forge, $22.50 to $23.50. Merchants bar, active with no change in prices.

The market for Foreign Iron remains dull and transactions small. We quote Gartsherrie at $25.50 to $26; Coltness, $26.50 to $26.75; Glengarnock, $24.50 to $25; Carnbroe, $24.50; Eglinton, $23.50 to $24; Summerlee, $26. Prime Wrought Iron Scrap is dull at $33, prime selected from the yard. Market for Copper barely steady. We quote Lake Superior at 19⅛c to 19¼c. Banca Tin, 29c. Straits and Malacca, 24⅞c. to 25c. Australian and Billiton 25¼c. Spelter, Western, 5¾c. to 5¾c. Refined, 8c. to 8¼c. Silesian, 5¼c. Lead, 5c. Antimony, 13c. to 14⅞c. for Foreign, and 13¼c. for Nevada.

WANTED

"Situation and Help" Advertisements, 30 cents a line, each insertion. About seven words make a line. Should be received Thursday morning.

A Mechanical Draughtsman desires re-engagement. Address "H," P. O. D. 38, New Haven, Conn.

Wanted—A good Machine Blacksmith, and 3 or 4 good Machinists. Address, EAGLE IRON WORKS, Des Moines, Iowa.

Mechanical Draughtsman, with 10 years experience in shop and office and technically educated, desires a situation. Address, H. Box, 1, AMERICAN MACHINIST.

Wanted—Situation as foreman or as toolmaker by machinist of 20 years experience. East & West references, etc. Address until April 6, "J. H.," Box 2, care AMERICAN MACHINIST office.

Wanted—Three good tool makers who can make tools for brass and iron fittings. Good wages and permanent employment given. Apply in person or by mail to "THE JOEL HAYDEN BRASS CO.," Lorain, Ohio.

Foreman Wanted—By a firm engaged in the manufacture of Steam Engines, Rolling Mill and Mining Machinery, must be steady, industrious and systematic. State age, experience and salary. Address, A. J. NUTTING & Co., Chicago, Ills.

Wanted—A man thoroughly experienced in Portable and Traction Farm Engine building, to design and superintend building them. Address, stating experience and references, JOHN S. DAVIS' SONS, Davenport, Iowa.

Wanted—A competent Mechanical draughtsman. One whose work is satisfactory, can secure permanent employment in a large manufacturing establishment. Address, P. O. Box 2227, New York City.

Wanted—Foreman for Foundry employing fifteen to twenty hands. Must have experience in engine and difficult cored work. Applicants must give references and state experience in dry and green sand and loam work. Address, A. W. H., Middletown, Ohio.

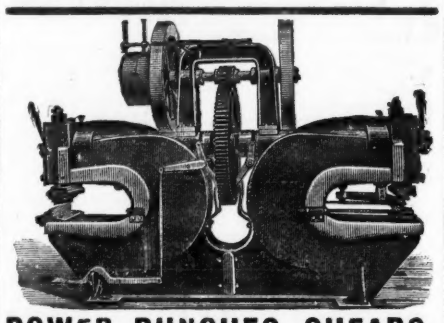
Mechanical Engineer, soon disengaged, is open for re-engagement, as resident engineer, heading draughtsman, foreman, etc. Large experience in designing heavy engines and machinery; Supt. Erecting Machinery, Buildings, etc. Good reference. Address, "H. P. S.," this office.

Wanted—Situation to take charge by a competent machinist and tool maker, with experience as foreman and contractor on light work, good designer, educated in modern shops, young and temperate, good reasons for leaving present situation. Address, "Contractor," BOX 4, AMERICAN MACHINIST.

Horizontal Engine, Plain Slide Valve, 20 by 48 for sale. Atlantic Steam Engine Works, Brooklyn, N. Y.

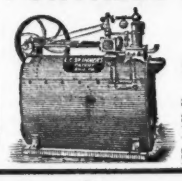
Wanted—Second-hand boiler Punch and Rolls. Address, Sam Griscom, 56 Butler st., Atlanta, Ga.

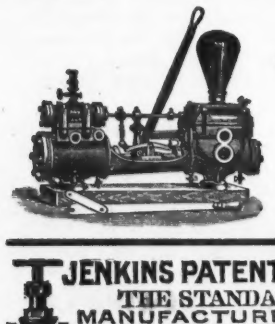
PORTER'S
Patent Belt Clamp,
which is illustrated and described in the news columns of this paper, can be found with
COOKE & CO.,
DEALERS IN
Machinery & Supplies,
6 CORTLANDT STREET,
NEW YORK.
Everyone using belts should have one of these ready in case of need. Many times its cost would be lost by not having the proper appliances to mend a break, which is liable to occur at any time during working hours.



POWER PUNCHES, SHEARS, HAMMERS.
We make over 100 sizes of Punches and Shears, Double and Single, varying from 500 to 36,000 pounds in weight, and adapted for every variety of work. The Double machines are equal to two Single ones, as each side is worked independently. Also
Adjustable Helve Cushioned Hammers
Of all sizes, unequalled for efficiency and durability
The Long & Allstatter Co.,
HAMILTON, OHIO.

FOR FUEL-SAVING CUT-OFF ENGINES.
For Dry Steam Portable Engines.
FOR CIRCULAR SAW MILLS.
For "MOORE COUNTY GRIT" CORN MILLS.
Address, Taylor Manf'g Co.
WESTMINSTER, MD.

PORTABLE and STATIONARY ENGINES
And BOILERS,

5 to 25 H. P. Parts duplicate and interchangeable, specially adapted to run Electric Light Machinery. Send for Circular.
SKINNER & WOOD, Erie, Pa.

Knowles' Improved Steam Pumps,
THE STANDARD!

Steam Pumps for Every Possible Service.
SEND FOR ILLUSTRATED CATALOGUE.
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THE STANDARD
MANUFACTURED OF BEST STEAM METAL.
JENKINS BROS. 71 JOHN ST. N.Y.
Holland, Thompson & Co., Troy, New York.
Manufacturers of the
HOLLAND LUBRICATOR.
For lubricating the valves and cylinders of steam engines. Operating with downward visible drop. The Principle of this Lubricator is entirely new; being the only one manufactured operating with a downward visible drop, and does not conflict with any other Patented Lubricator. Protected with Letters Patent, granted June 8, 1881.

☞ A saving of from 50 to 90 per cent. in cost of oils.
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HAND & POWER SHAPING MACHINES. Full length of stroke 6 in. May be adjusted to any less distance desired. Automatic cross feed, with 6 in. traverse. Vertical adjustment of table, 6 inches.
For full particulars apply to
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WE CHALLENGE THE WORLD FOR ITS EQUAL
RUFFNER & DUNN,
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Patentees and Sole Manufacturers of the Excelsior Steel Tube Cleaners. $1.00 per inch. Most liberal discounts to dealers. Send for circular.

WORCESTER MACHINE SCREW CO.

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MANUFACTURERS OF
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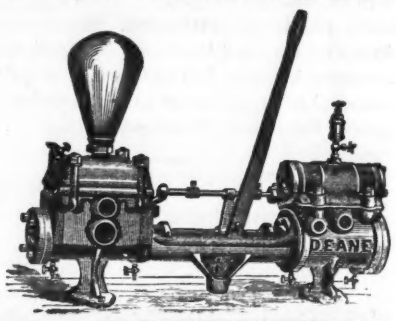
"THE DEANE" STEAM PUMPS FOR EVERY SERVICE.
Send for New Illustrated Catalogue.
The Deane Steam Pump Co.
HOLYOKE, MASS.
92 & 94 Liberty St., New York. 54 Oliver St. Boston. 226 & 228 Lake St., Chicago.


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Factories and Warehouses. Their Sanitary and Fire-resisting Arrangements. By B. H. THWAITE. C. E., with 183 illustrations of the most improved Fire, Sanitary and Ventilating arrangements. 8vo, cloth, $3.50. Free by mail.
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Improved Combustion of Coal and Its Gases.
Saving in Fuel. Burns all kinds. Increased capacity of Furnace. A Ventilated Grate-Bar. No New or Peculiar Boiler Setting. A Simple Device for Economy.
The Fairbairn Manufacturing Co.,
272 PURCHASE STREET,
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ROOFING.
For steep or flat roofs. Applied by ordinary workmen at one-third the cost of tin. Circulars and samples free. Agents Wanted. T. NEW, 38 John Street, New York.

THE CAMERON STEAMPUMP.
Is the Standard of Excellence
AT HOME AND ABROAD.
THE A. S. CAMERON STEAM PUMP WORKS,
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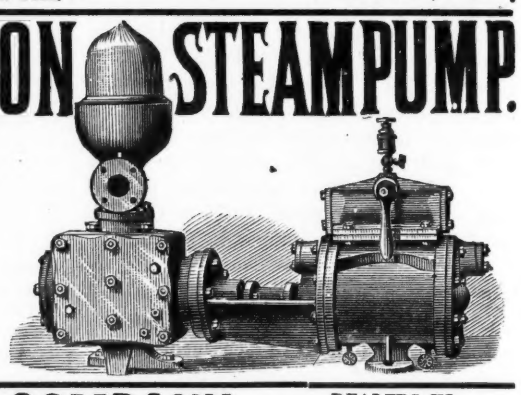

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Tools & Supplies.

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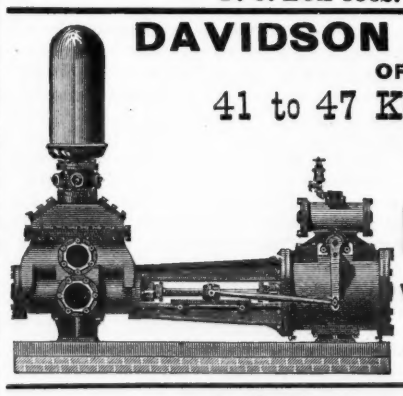
OFFICE AND WORKS:
41 to 47 Keap Street, Brooklyn, N. Y.
MANUFACTURERS OF
THE M. T. DAVIDSON
Improved Steam Pump.

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ANY CAPACITY. WESTON'S PATENTS.
Can be Operated by Hand or Power.
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Simple, Durable, Convenient and Economical.
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PLANS AND ESTIMATES FURNISHED FREE.
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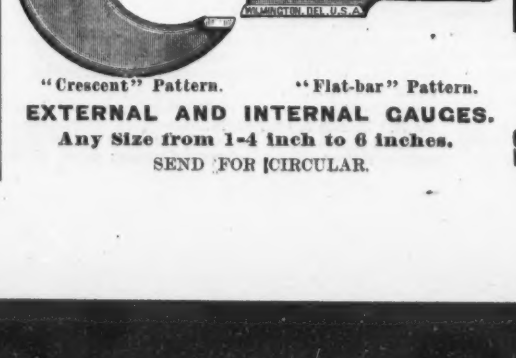

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EXTERNAL AND INTERNAL GAUGES.
Any Size from 1-4 inch to 6 inches.
SEND FOR CIRCULAR.

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MAKERS OF
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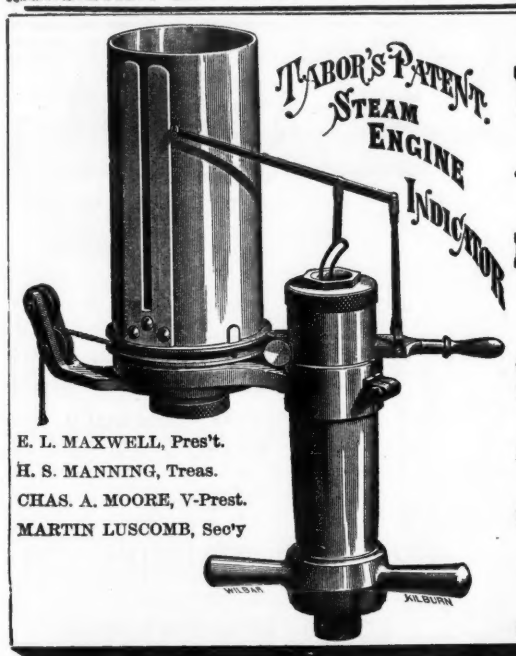

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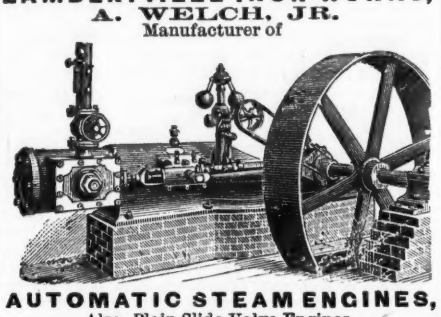

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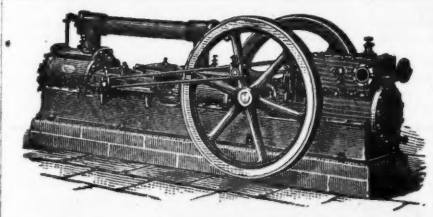

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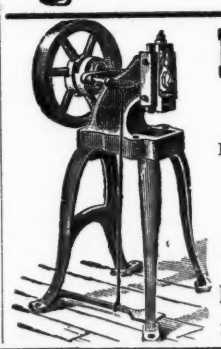

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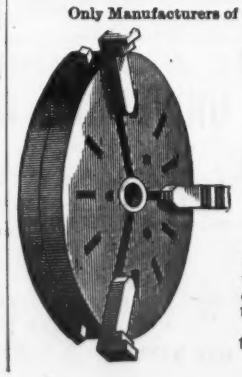

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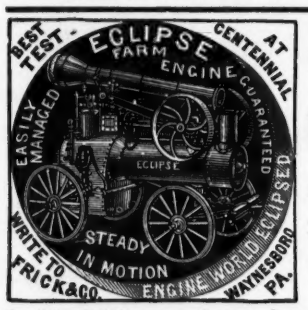

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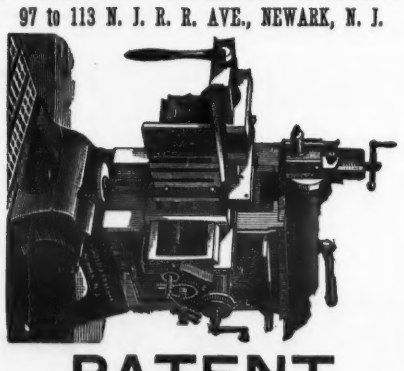

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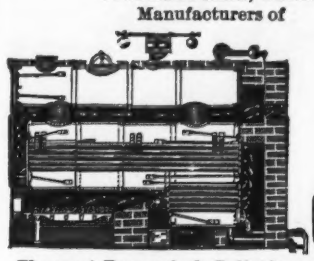

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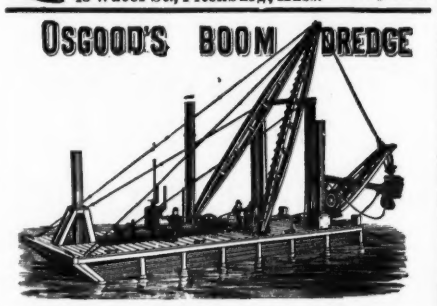

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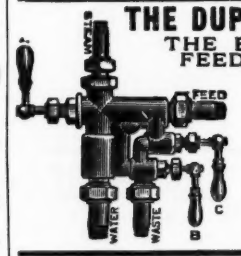

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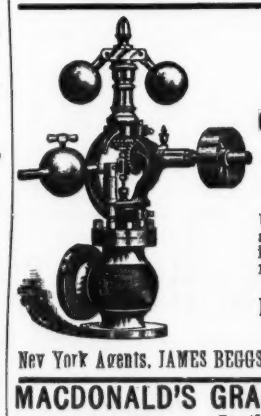

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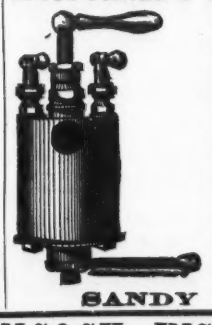

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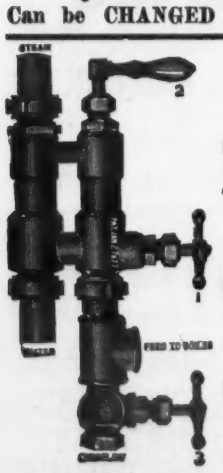

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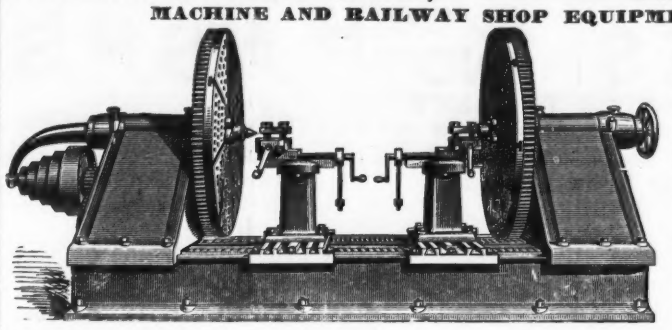

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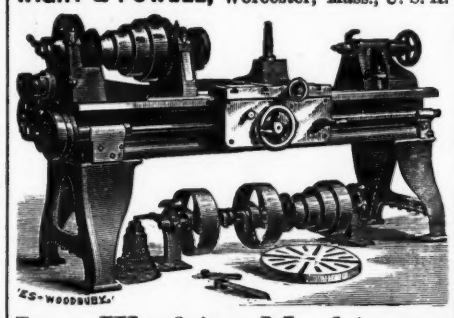

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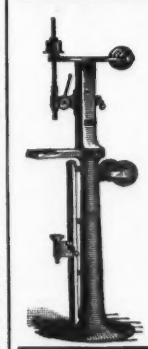

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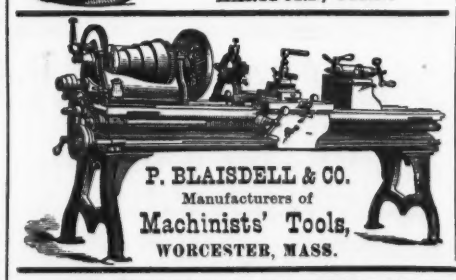

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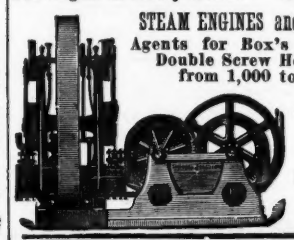

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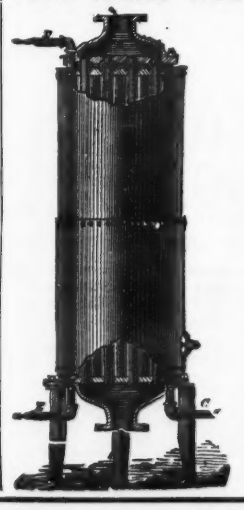

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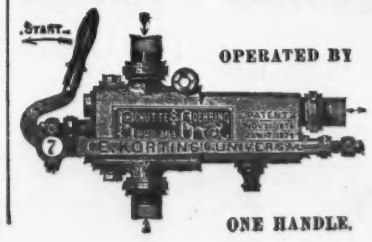

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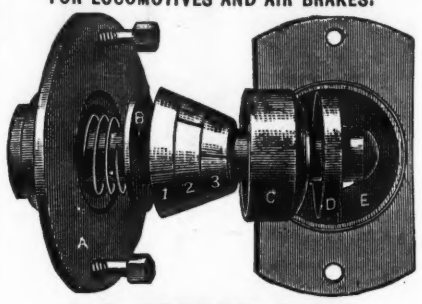

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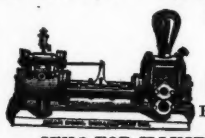

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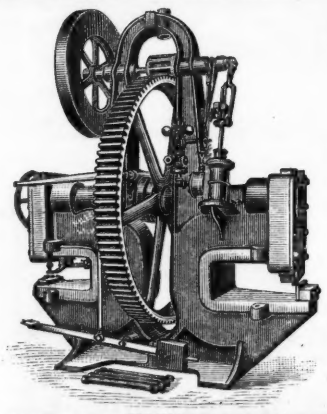

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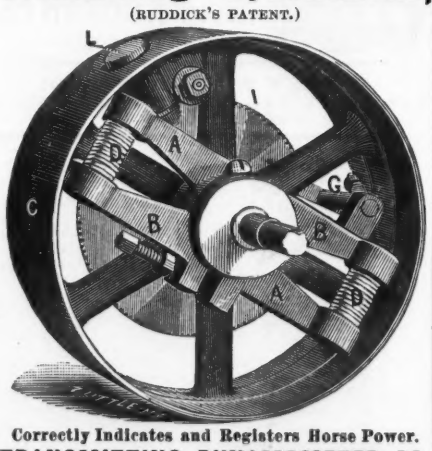

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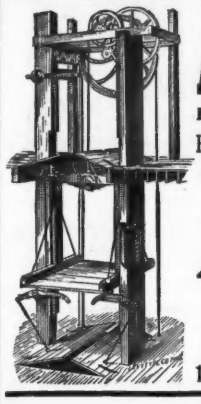

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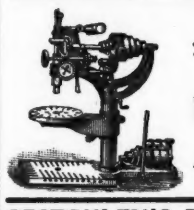

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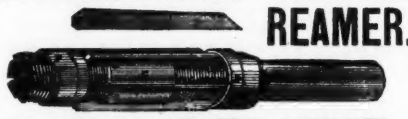

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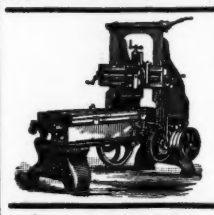

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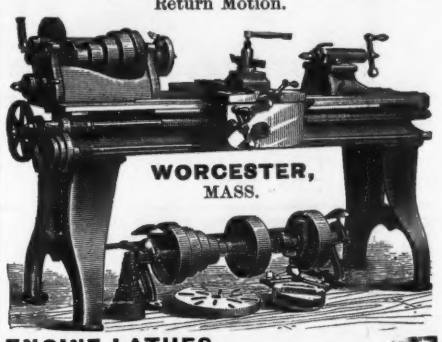

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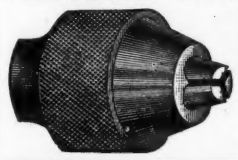

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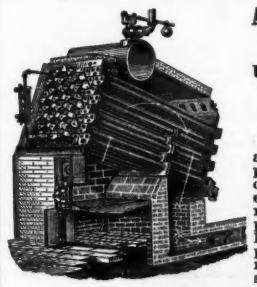

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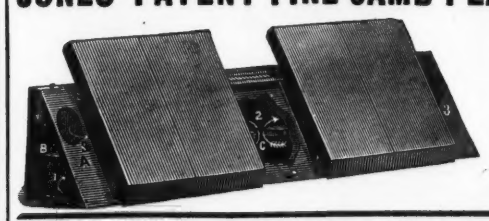

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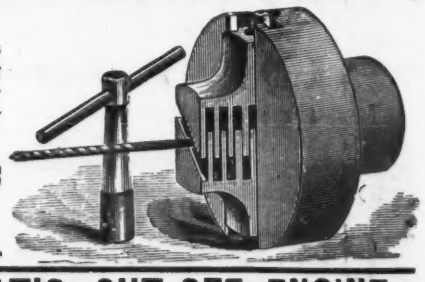

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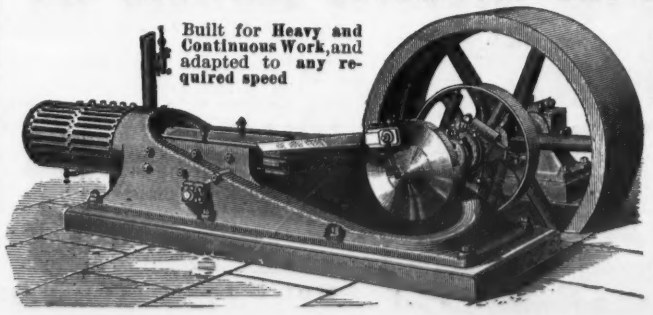

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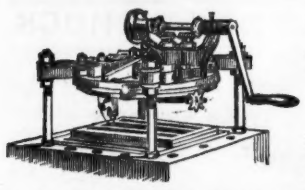

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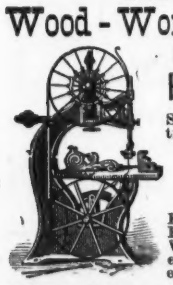

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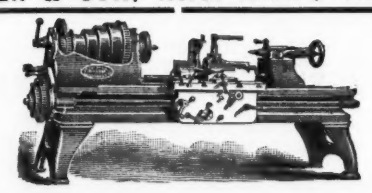

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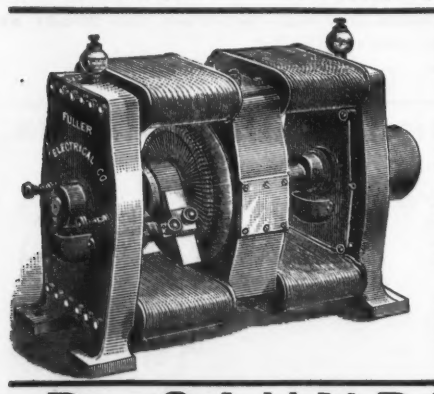

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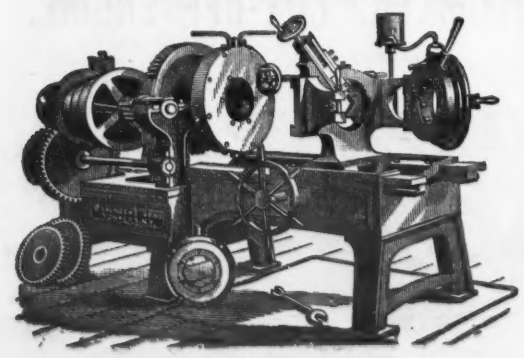

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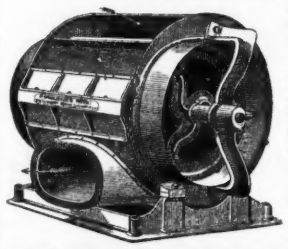

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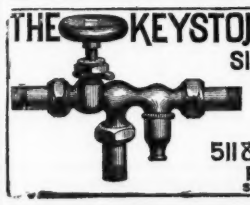

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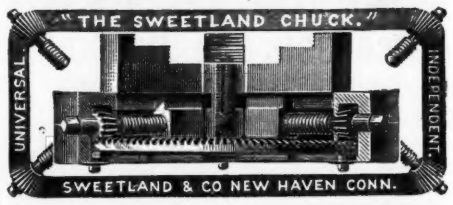

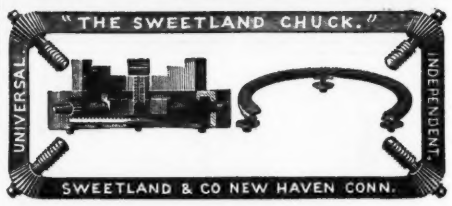

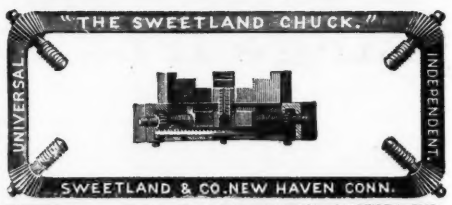

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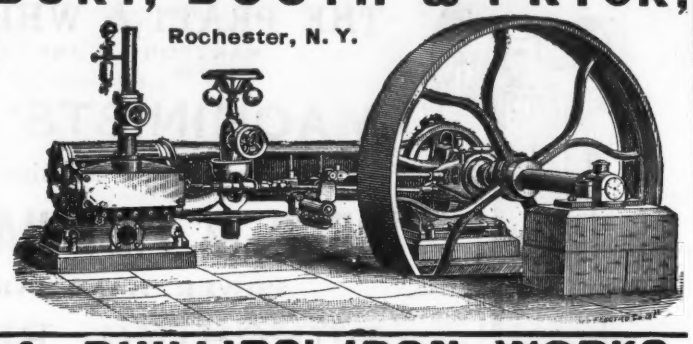
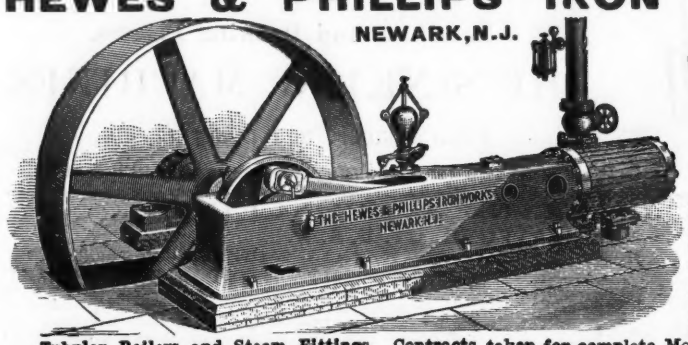


HEWES & PHILLIPS' IRON WORKS,

NEWARK, N.J.



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The ALLEN PATENT HIGH-SPEED ENGINE.

Both Condensing and Non-Condensing, especially designed and constructed for the Rolling and Cotton Mill Trade, and all establishments requiring an absolutely uniform and economical power.

Tubular Boilers and Steam Fittings. Contracts taken for complete Motive Power Outfits.

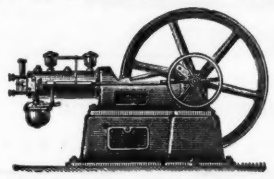
NEW OTTO SILENT GAS ENGINE.

Working without Boiler, Steam, Coal, Ashes or Attendance.

Started Instantly by a Match, it gives full power immediately.

When Stopped, all Expense Ceases.

No explosions; No Fires nor Cinders; No Gauges; No Pumps; No Engineer or other attendant while running.



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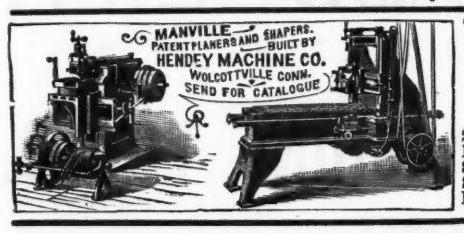

The Hendey Machine Co.

TORRINGTON, CONN., U. S. A.

Manville Patent Iron Planers and Shapers.

15 in. Shapers, 24 in. Shapers, 3½ ft. x 16 in., 5 ft. x 20 in., 6 ft. x 24 in., 8 ft. x 24 in. Planers, Amateurs' Hand Planers, with chuck and centers, Hollow Steel Spindle Hand Lathes, Brass and Wire Slitters, Spring Chuck, and Common Clock Lathes. Catalogue gives many names of users of our tools.

Large Iron Planer for Sale.

Full capacity of Planer, 26 ft. long; 4 ft. wide; 3 ft. high. For particulars address,

S. T. LUND, 71 OLIVER STREET, BOSTON, MASS.

Second-Hand & New MACHINERY.

MARCH 15, 1882.

One	Car Axle Lathe.	Hewes & Phillips.	New.
One	Engine Lathe, 36 in. x 15¾ ft.		A1 order.
One	" " 28 in. x 16 ft.	Fifield.	New.
One	" " 28 in. x 12 ft.	"	"
One	" " 24 in. x 12 ft.	"	"
One	" " 24 in. x 10 ft.	"	"
One	" " 24 in. x 10 ft.	New Haven.	
One	" " 20 in. x 12 ft.	Ames.	New.
One	" " 20 in. x 10 ft.	"	"
One	" " 20 in. x 8 ft.	"	New.
One	" " 18 in. x 9 ft.	Whitc'b.	Good order.
Three	Engine Lathes 18 in. x 8 ft.	Jones & Lamson	New.
One	Engine Lathe, 16 in. x 6-7-8 ft.	Bridgeport Mch. Tool Works.	New.
Six	Engine Lathes, 16 in. x 6 ft.-7ft. x 8 ft.	Ames.	New.
Two	" " 15 in. x 6 ft.	Jones & Lamson.	New.
One	" " 15 in. x 6 ft.	Frather's.	New.
Three	" " 14 in. x 6 ft.	Star Tool Co.	New.
One	" " 14 in. x 6 ft.	Hand.	New.
One	" " 13 in. x 6 ft.	Ames.	New.
One	" " 13 ft. x 4½ ft.		
One	" " 12 in. x 6 ft.	Lincoln.	
One	" " 11 in. x 5 ft.		
One	Hand Lathe. 12 in x 5 ft.	Hendey.	New.
One	" " 7 in. x 2½ ft.	NewSpencer.	
One	Planer 17 in. x 3½ ft.		Good order.
One	" 20 in. x 5 ft.	Ames.	New.
One	" 24 in. x 5 ft.	New Haven.	Good order.
One	" 24 in. x 6 ft.	Whitcomb.	New.
One	" 37 in. x 10 ft.	Gleason.	A1.
One	6 in. Stroke Shaper.	Boynton.	New.
One	15 in. Stroke Shaper.	Hendey.	New.
One	15 inch Stroke Shaper.	Gould & Eberhardt.	New.
One	20 in. Stroke Shaper.	G. & E.	New.
One	24 in. Stroke Shaper.	Hendey.	New.
One	Screw Machine.	New Pattern.	
One	20 in. Upright Drill.	Prentiss.	New.
One	24 in. " "	Ames.	New.
One	38 in. " "	New Haven.	New
One	Suspension Drill.	Kidd.	Good order.
Three	Sensitive Drills.		
25	Lincoln Millers and Vises.		Good order.
One	No. 3 Garvin Hand Miller.		New.
One	15 lb. Air Hammer.	Hotchkiss.	Good order.
One	200 lb. Bradley Hammer.		A1.

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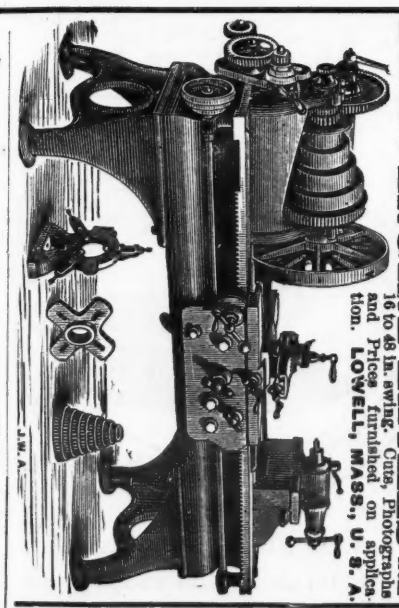
General Eastern Agent for

AKRON IRON CO.'S Patent Hot Polished SHAFTING.


GEO. W. FIFIELD,
Manufacturer of ENGINE LATHES
16 to 48 in. swing. Cuts, Photographs and Prices furnished on application.
LOWELL, MASS., U. S. A.

HILL, CLARKE & CO.

36 OLIVER STREET, BOSTON, MASS.

NEW MACHINE SHOP TOOLS.

List of Sizes for Quick Delivery.

LATHES.

13 in.	swing,	6 ft.	bed.	Ames.	
15 "	"	6 "	"	Reed.	
15 "	"	8 "	"	"	
16 "	"	6 "	"	Ames.	
16 "	"	8 "	"	"	
16 "	"	6 "	"	Nutted.	Barnes.
19 "	"	8 "	"	Gray.	
20 "	"	10 "	"	Fifield.	
20 "	"	12 "	"	"	
21 "	"	10 "	"	Blaisdell.	
21 "	"	12 "	"	"	
24 "	"	10 "	"	"	
24 "	"	12 "	"	"	
26 in.	swing,	26 ft.	bed	Powell.	
36 "	"	16 "	"	Fitchburg	(on hand.)

PLANERS.

16 in. x 16 in. x 3½ ft.	Parker.	
20 in. x 20 in. x 5 ft.	Hendey.	
22 in. x 20 in. x 4 ft.	Pond.	
22 in. x 22 in. x 4 ft.	Powell.	
24 in. x 24 in. x 6 ft.	Ames.	
24 in. x 24 in. x 6 ft.	Hendey.	
27 in. x 27 in. x 8 ft.	Whitcomb.	(on hand.)
30 in. x 30 in. x 10 ft.	Fitchburg.	
32 in. x 32 in. x 10 ft.	Gleason.	
36 in. x 36 in. x 10 ft.	"	

2 No. 2 Cabinet Turret Lathes—deliver in one week.

THE PORTER-ALLEN HIGH SPEED ENGINE.

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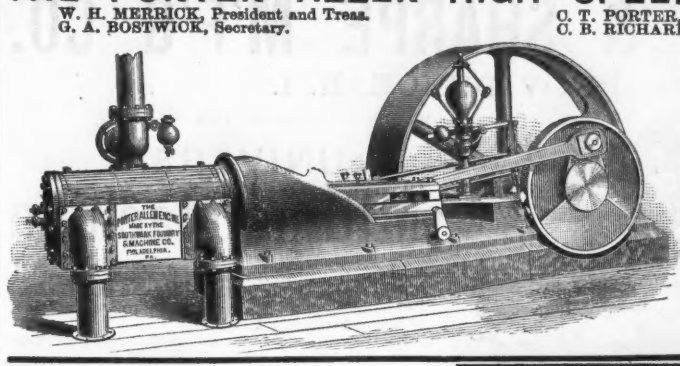

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Orders solicited for Iron and Brass Castings in the rough.

Address the Company, 430 Washington Avenue, Phila., Pa.

IRON PLANERS,
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ENGINE LATHES,
IRON SHAPERS,
ENGINES & BOILERS

A GENERAL LINE OF

IRON AND WOOD WORKING

MACHINERY.

TOOLS & SUPPLIES

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PATENT SOLICITOR & EXPERT,
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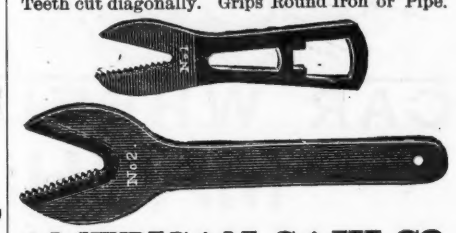
THE ALLIGATOR WRENCH,

Patented Aug. 31, 1875.

Teeth cut diagonally. Grips Round Iron or Pipe.



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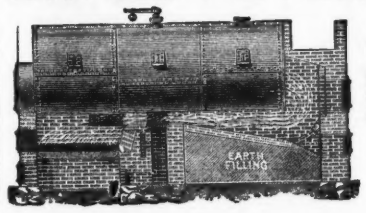
TRENTON, N. J.

JARVIS PATENT FURNACE FOR SETTING STEAM BOILERS.



Economy of Fuel, with increased capacity of steam power. The same principle as the SIEMENS' PROCESS OF MAKING STEEL, utilizes the waste gases with hot air on top of the fire. Will burn all kinds of Waste Fuel without a blast, including screenings, wet peat, wet hops, sawdust, logwood chips, slack coal, &c.

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NEW AND SECOND-HAND MACHINERY

For Sale, in Store March 17th, 1882, at Chicago, Ill., by W. A. James & Co.

New Planers.

One	9 ft. x 32 in. x 32 in.	Betts Machine Co.
One	11 ft. x 36 in. x 36 in.	" " "
One	13 ft. x 36 in. x 36 in.	" " "
One	8 ft. x 26 in. x 26 in.	Pond.

Second-Hand Planers.

One	4 ft. x 24 in. x 20 in.	New Haven Mfg. Co.
One	7 ft. x 24 in. x 24 in.	Cone Machine Co.
One	8 ft. x 33 in. x 26 in.	Williams, Rich & Co.
One	6 ft. x 26 in. x 26 in.	Aldrich.
One	14 ft. x 72 in. x 48 in.	Schenectady.
One	3 ft. x 17 in. x 12 in.	Lathe & Morse.

New Engine Lathes.

One	18 ft. x 48 in.	Fifield.
One	18 ft. x 36 in.	"
One	16 ft. x 22 in.	"
One	12 ft. x 24 in.	"
One	16 ft. x 26 in.	Perkins.
One	20 ft. x 36 in.	Fifield.
One	8 ft. x 20 in.	Perkins.
One	16 ft. x 26 in.	Niles Tool Works.
One	6 ft. x 16 in.	Perkins.
One	8 ft. x 17 in.	"

Second-Hand Engine Lathes.

One	12 ft. x 39 in.	New Haven.
One	18 ft. x 32 in.	"
One	11 ft. x 28 in.	Ames Mfg. Co.
One	15 ft. x 24 in.	Double Head.
One	17 ft. x 32 in.	New Haven.
One	10 ft. x 20 in.	Lathe & Morse.
One	6 ft. x 15 in.	Putnam.
One	7 ft. x 19 in.	Lathe & Morse.

Great variety Shapers, Pulley Turning Machines and Grinding Machines will be sold cheap by

W. A. JAMES & CO.,
273 & 275 South Canal St., Chicago, Ill.

SECOND-HAND and NEW MACHINERY

March 15, 1882.

The following New and Improved Machinists Tools are part of what we have for early delivery.

1	36 in. x 36 in. x 9 ft.	Iron Planer.	2d-hand.	March	
2	30 in. x 30 in. x 8 ft.	Planers.	New.	April.	
2	26 in. x 26 in. x 6 ft.	"	"	March.	
2	30 in. swing, 15 ft. bed.	Engine Lathes.	March.		
1	22 in. swing, 13½ ft.	Bed Engine Lathes.	"		
5	22 in. x 12 ft.	Engine Lathes.	April.		
3	19 in. swing, 10 ft.	Bed Engine Lathes.	March.		
3	18 in. " 8 ft.	"	"	"	
4	11 in. " 5 ft.	"	"	"	
2	30 in. "	Upright Back Geared Drills.	"		
2	9 in.	Shapers. New. March.			

The following on hand:

1	18 in. swing, 6 ft.	Bed Engine Lathe.	2d-hand.		
2	19 in. " 10 ft.	"	"	"	New.
2	19 in. " 8 ft.	"	"	"	"
1	18 in. " 8 ft.	"	"	"	"
1	15 in. " 5 ft.	"	"	"	"
1	17 in. " 6 ft.	"	"		2d-hand.
1	17 in. " 7½ ft.	"	"	"	"
1	15 in. " 15 ft.	"	"	"	"
2	14 in. " 6 ft.	"	"		New.
1	12 in. " 4 ft.	"	"		2d-hand.
1	12 in. " 4 ft.	"	"		New.
1	15 in. " 9 ft.	Hand Lathe.	New.		
1	12 in. " 6 ft.	Bed Hand Lathe.	New.		
1	10 in. " 4½ ft.	"	"	"	
1	Boring Lathe, 16 ft. bed. 48 in. swing.				
1	Round Arbor Fox Lathe. Fine order.				
1	21 in. x 4 ft.	Whitcomb.	Planer.		
2	48 in. Swing Radial Drills.	New.			
2	38 in. Swing Upright Drills.	B. G. & S. F.	New.		
1	20 in. Upright Drill.	Back Gear.	New.		
1	21 in. Upright Drill.	Nearly New.			
1	18 in. Bench Drill.				
2	Wall Drills, heavy.	Second-hand.	60 and 72 in		
1	10¼ in. x 23 in. Shaper.				
1	6 in. Shaper.	New.	Hand or Power.		
2	Milling Machines, Lincoln pattern.	Second-hand			
2	Manhattar Arms Co. Millers.	Second-hand.			
1	Sellers Milling Machine.	2d-hand.			
1	Face Milling Machine.	Second-hand.			
1	Pond's Double Milling Machine.	2d-hand.			
1	No. 2 Screw Machine.	New.	Turret Head.		
1	Screw Head Slotter.	Second-hand.			
2	Second-hand Profiling Machines.				
1	Vertical Centering Machine.	Nearly new.			
5	4½ in Hyde's Patent Centering Machines.	New.			
1	Emery Grinder,	2d-hand.	Small.		
1	Pipe Cutting Machine.	Second Hand.	2 in.		
1	1¼ in. Wood & Light Bolt Cutter.	New.			
1	Wells Bros. 1½ in. Bolt Cutter.	New.			
1	Bolt Pointing Machine.	Second-hand.			
1	Double Nut Tapper.	New.			
1	Horizontal Boring Mill, 48 in. Swing.				
1	Horizontal Boring Machine, Small.	2d-hand.			
1	Betts, No. 2, Power Punch.	New.			
4	Double-Acting Presses, No. 3,	nearly new.			
4	Single-Acting Presses, for power,	"			
100	Foot Presses,	nearly new.			
1	Medium Power Punching Press.	Second-hand.			
2	Small "	" Presses.	"		
1	Foot Punch, with bench.	New.			
1	Lot Pistol Machinery.	Second-hand.			
1	Grind Stone and Frame.				
1	300 lb. Steam Hammer.	2d-hand.			
1	Crane.	Second-hand.	20 ft. jib.	6 Tons.	
1	4 Side Moulding Machine.	New.	8 in.		

Lot of Forges 1 Band Saw, 1 Slat Tenoner, 1 Railway Saw Bench, 1 Foot-power Circular Saw, Cold Rolled Shafting, Pulleys, Hangers, Couplings, &c., always in store.

The George Place Machinery Agency,

121 Chambers and 103 Reade Sts., New York.

BROWN & SHARPE M'F'G CO.

PROVIDENCE, R. I.

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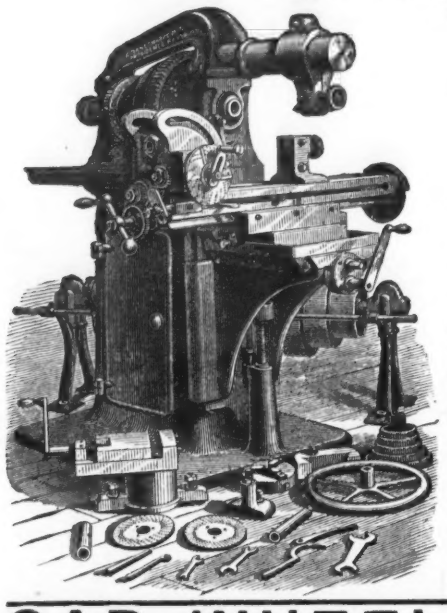

UNIVERSAL Milling Machine

This Machine has been designed especially to meet the wants of Steam Engine and Locomotive builders, and others engaged in the manufacture of heavy machinery and tools.

The essential features and motions are the same as in our smaller Universal Milling Machine, with such enlargement of the whole machine and its parts as would best adapt it for the class of work to be done. The cone has three diameters, each 3½ inches face. In addition, the cone is strongly geared, thus making six changes of speed. There are, also, the same number of changes of feed. The spindle boxes are of hardened cast steel, and, together with the spindle bearings, are carefully ground, and are provided with means of compensation for wear. The spindle will carry a cutter arbor projecting 15 inches, which is supported by an adjustable center at the outer end. Cutters of 8 inches or less diameter can be used. The horizontal movement of the spiral clamp bed upon the knee, in a line with the spindle of the machine, is 6½ inches, and the vertical movement of the spiral bed centers below the spindle centers is 11 inches. The spiral bed can be set at angles of 35° each way from center line of spindle, and can be fed automatically 22 inches, taking also 22 inches between the centers, and will swing 11¼ inches.

☞ Illustrated Catalogue sent per mail on application.

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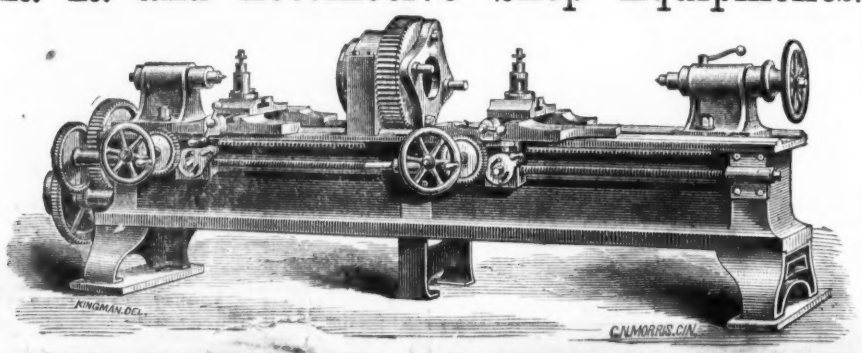
R. R. and Locomotive Shop Equipments.



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CINCINNATI, O.
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18" ENGINE LATHES AND TURRET LATHES.

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Emery Wheels & Grinding Machines.

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Boston, 21 Doane St.
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St. Louis, 811 to 819 North Second St.
Cincinnati, Cor. of Pearl & Plum Sts.
Pittsburgh, 137 First Ave.
Indianapolis, Cor. Maryland & Delaware Sts.
New Orleans, Cor. Union and St. Charles Sts.
San Francisco, 2 & 4 California St.
Portland, Oregon, 43 Front St.
London, Eng., 9 St. Andrew's St., Holborn Viaduct, E. C.
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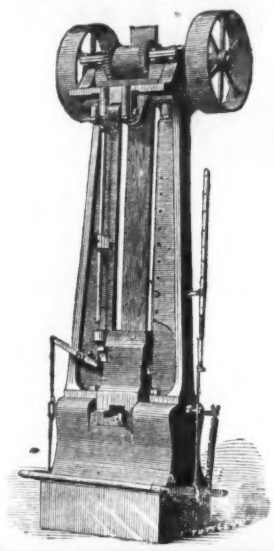

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This Drill can be changed from **Right to Left Hand Drilling** by simply moving the Pawl to right or left.

Price for 10¾" with Socket, to Handle Drills, from ¼" to 29-32" inclusive, and Socket, for Square Shank Drills, $14.00.

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Having found it necessary to build a **FOUNDRY** to insure the success of their own work, are prepared to promptly execute all orders for first-class machinery **CASTINGS.**

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Will true a stone in ten minutes, WITHOUT DUST. Guaranteed satisfactory. Price, $15.00.

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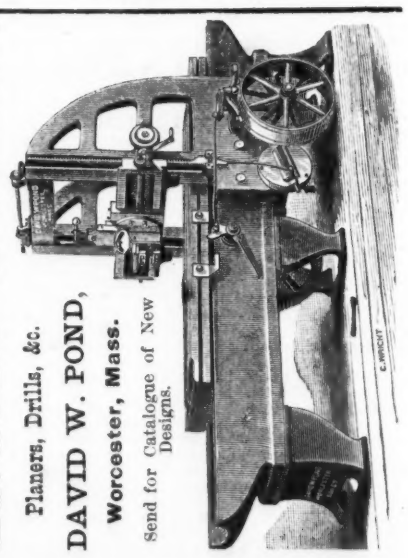

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Planers, Drills, &c.

DAVID W. POND,
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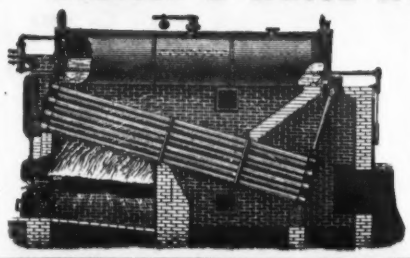
Send for Catalogue of New Designs.

Babcock & Wilcox Water-tube Steam Boilers.



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3,678 H. P. in use by SINGER MF'G CO., New York; 3,790 H. P. by HARRISON HAVEMEYER & CO., Philadelphia; 2,880 H. P. by DECASTRO & DONNER SUGAR REFINING CO., Brooklyn; 4,600 H. P. by AMERICAN GRAPE SUGAR CO., Buffalo; 1,350 H. P. by THE JESSUP & MOORE PAPER CO., Wilmington; 720 H. P. by RARITAN WOOLEN MILLS, New Jersey; 600 H. P. by STUDEBAKER BROS. MF'G CO., South Bend, Ind., and hundreds of others in all kinds of business, from 50 H. P. to 2,000 H. P. each.

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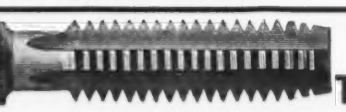

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